Electrical World

McGraw-Hill Company, Inc. New York, March 22, 1919 15c a copy

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, March 22, 1919 *Number* 12

Boston Meeting of the A. I. E. E.

THE Boston meeting of the American Institute of Electrical Engineers was in keeping with the best traditions of that body. The character of the addresses and papers as well as the diversity of interests represented in the audience shows what can be accomplished in Institute affairs when there is a will and a determination to do. The railway electrification problems were discussed without reference to the battle of the systems and in a national and constructive manner. There was a realization that electrification of railways involves broader engineering than the mere substitution of an electric locomotive for a steam locomotive, and that the problem must be considered in connection with other national issues not intimately connected with, yet affecting, the electrical industry. It is refreshing to feel that the electrical industry is becoming broad enough and public-spirited enough to associate electrification, for instance, with fuel conservation and water-power development. The subject of technical education brought up at the evening session was admirably handled, and certainly the addresses of prominent educators, notably that of Dr. Eliot, were most inspiring. One naturally associates Boston with culture, so that pearls of wisdom were not lacking, and if there be anything in modern prophecy, the vision which Dr. Eliot holds of engineering, colored as it must be by his ripened experience and mellow philosophy, is certain of ultimate realization.

Rural development, which is so essential for the security of the nation, can be hastened by means of electricity. No other single agency possesses the power to make the remote sections of the country so attractive. The more electrical networks spread out, the quicker new towns and communities develop.

Water Power Must Be Developed

IT IS becoming increasingly clear that if water-power development is to be a reality, it must be the business not only of those directly interested in specific projects but of every public utility and every citizen of the country as well. From now on until proper legislation is enacted there must be throughout the length and breadth of the land continuous discussion of the subject of water powers and the relation their development bears to the country as a whole. Only in this way can a policy be translated into achievement. We must have informed public opinion working its will on every Representative and Senator. It is time that every one realized that development of water power is a national problem which concerns every citizen of the country, and the electrical industry, to which must be intrusted the development of these water powers, must work unselfishly with the rest of the country to bring such a condition about. While it is true that the industry will profit somewhat by water-power development, its reward for services rendered is as nothing compared with the advantages which such work brings to the entire human race. When manufacturers realize that only through water power can reasonably priced power for industry be obtained, and when every householder senses that through the same agency the coal resources of the country will be conserved and the day for fabulously priced coal be postponed for a longer period, then will come the realization that others besides those connected with the electrical industry are vitally concerned in this problem. No one begrudges the doctor his fee if by that means the health of a community can be maintained or its sanitary condition improved. A like situation should obtain with reference to water-power development, and every one in the industry should emulate the example of the eminent Roman, Cato, and insist not that "Carthage must be destroyed" but that "water power must be developed."

Commerce reports bring the information that Bulgaria, in anticipation of a revival of trade after the war, developed water-power facilities, created a bank for the promotion of trade and formed a variety of banks, with a total capitalization of $50,000,000, for the financing of industry. And yet we think of the Balkan countries as backward.

Design of Small Direct-Current Armatures

IN THE process of reëstablishing industries after the return of peace, electric distribution of power to machinery is bound to play an important part, in order that the most economical and effective use may be made of factory machinery. The average factory motor is of comparatively small power. Consequently the economical design of good small motors is a matter of considerable importance.

Small direct-current motors have been designed, built and industrially employed for many years. It would, however, be very unsafe to assume that there is no more room for improvement in them on that account. Even assuming that no general and sweeping improvements are possible in their design, there must always be possible improvements in detail, due to new available materials, new processes of construction and changes in the relative costs of steel, copper and other elements in the total expenses of building.

C. R. Wylie's article on the subject, in this week's issue, deals with the essential design constants of small direct-current armatures. The data are presented

mainly in curve sheets, and many of the curves appear to be of the exponential type, or to follow straight lines, when plotted on logarithm paper. It is interesting to notice that the cost of small dynamos is indicated as having increased about 15 per cent between 1915 and 1917, owing to war conditions.

Dr. Eliot's recent remark that it is inexpedient, not to say absurd, to attempt to fix by law the same number of hours for all industries without regard to their infinite diversities, or for all establishments in the same industry, is economically indisputable. Irresponsible demands for a rigid wholesale limitation of the day's work are only a degree less culpable than advocacy of individual restriction of output. Increased production per expense unit is the line of least resistance to follow in international competition.

Opposing Government Operation

THERE are selfish reasons against government ownership or operation of our carrier and wire utilities just as there are selfish reasons for those policies. Is the ultimate disposition of these great utilities to be determined by selfish motives? Will the decision then fall to those whose motives are the most selfish, to those who best succeed in concealing their motives from the public or to those who by freak of chance have the most power to attain their ends? If a thorough understanding of the facts prevails, the question will be settled ultimately, not as selfish motives would determine it, but as economic considerations recommend. Those who oppose government ownership or operation should give their attention to the economic problems involved in the momentous issue. It is not enough to assume that because they think that public operation is wasteful the public will inevitably think so too. They must be prepared to prove their case.

Bankers who recall the profits of unregulated public utility corporations face a new responsibility, a heavier one in some ways, under the conditions that will obtain if the railroad and wire properties are returned to their owners. The turnover in securities will be less profitable. Manipulation will be dangerous. But while the time of exploitation is passed, the era of fair regulation substitutes equitable return on the investment. This is the alternative which those who oppose government ownership should be prepared to accept. It means less profit for the banker and promoter; it means a surer stabilized return for the real investors whose capital or savings aggregate the corporate investment. It may also be kept in mind that the idea of trusteeship is capable of much higher development than many people have accorded it. We do not mean the revival of the "widows and orphans," for their funds have not always been safeguarded in bygone days; but there is a sense in which the controlling individuals can exercise a trust equally for those who own, those who man and those who use the properties. This form of corporate trusteeship can be made more economical in administration than the operation of a bureau under our present practice in government.

What policy and under whom will best safeguard the public interest? Will it be private ownership with public operation? That is what we have now with the railroads and wire agencies. In principle it amounts to public use of private property for a return, but the individual holder has no opportunity to debate or question that return. Investment and property may be depreciated in the process. Public ownership and operation would mean enormous investment, a horde of government employees in politics. Private ownership and operation under regulation would be in part a continuation of the pre-war conditions, in part new conditions growing from experience. It is the practicable solution of which we have the most knowledge. Its defects are remediable, its abuses negligible.

The basis of the decision should be the conservation of capital investment, economy in operating expense, efficiency and low cost in service. Those who oppose permanent government operation of the properties now held under the direction of the administration face these facts: The administration appears to be reluctant to surrender its control. Rates have been increased heavily, also wages. Service is restricted. Competition has been abandoned. Coördination of properties must have brought some net economies, but evidently not enough to offset larger costs. Can these conditions be bettered? It is clearly up to those who oppose a continuance of present conditions to show, not merely hostility, but that with equal opportunities and fair regulation they can do better than the government. It is up to them not to complain against unfair treatment, but to support any claim that they make that they can do better. If the private owners or their representatives get the properties back, the public will not submit to a fiasco. It will demand results, and private owners cannot as easily find acceptable excuses for shortcomings as public operators.

The leaven of electricity has had results, and the uncharted future will be gained or lost according to what advantage is taken of the situation at present existing in the industrial world. If public utilities will purify themselves by eliminating the bad and invigorating what is good, we shall have a renaissance which will establish the central station more firmly and completely than ever.

Vacuum-Tube Amplifiers

ONE of the most wonderful devices in the world is a vacuum-tube amplifier. It corresponds in the electric field to the microscope in the optical field. But the range of available magnification of the electrical device is enormously greater than the greatest available magnification of the optical device.

Clerk Maxwell at one time suggested a purely ideal permeable barrier, which might enable work to be obtained thermally from the heat energy of gas in a closed chamber, without the application of heat from outside. The molecules of the gas are supposed to be vibrating and colliding through a sort of perpetual motion. As a result of this mode of action, each and every molecule is occasionally jarred into a high instantaneous velocity, while at other times it may give up nearly all its momentum to a colliding molecule. According to the law of probabilities, the root mean square of the velocity of any and all the molecules would remain strictly constant and in conformity with the temperature of the gas inside the chamber.

Across the middle of the space within the chamber a peculiar and ideal partition or barrier was to be established. In this barrier a great number of minute trap doors were to be set, in such a manner that each

might suddenly be either widely opened or tightly closed. When toward the door on one side, say the *A* side, came a gas molecule with high velocity, the door would be opened to allow passage to the *B* side. When, however, a molecule came up with less than the root-mean-square velocity, passage would be denied. By this means the temperature on the *A* side of the partition would gradually be lowered, while on the *B* side it would be raised. The difference of temperature thus gained would enable subsequent mechanical work to be done.

In the vacuum-tube amplifier a metallic grid takes the place of the ideal partition, and electrons are allowed to pass or are held back according to the electric potential given to the grid. The result is, not a change in temperature, but a marked change in the density of an electron stream or electric current. The power necessary to produce the electric current is dispensed by a suitably arranged direct-current source, but the flow or cessation of the current is determined by the grid potential, at the expense of a much smaller electric power.

Lieut. Max C. Batsel's article in this issue describes the vacuum-tube amplifiers developed by the Signal Corps for various signaling systems. In particular, a seven-stage amplifier is described, with three stages for radio-frequency amplification, leading to a detector stage, and then followed by three stages of audio-frequency amplification. This makes a combination well adapted for use with radio direction finders.

Laissez faire and doctrines of like sort can have no place in the electrical industry. We have no room for reactionaries, either. Progress and initiative must be the guiding principles of our public utilities. Economies learned during the war must be held and even bettered. The industry must go forward, not backward, and interconnection is a forward step.

The Commission and Public Policy

WHEN the people of a state are satisfied with the treatment they receive from their public utility companies the commission form of regulation is accepted as a matter of course. But should dissatisfaction arise from any cause the innocent commission as well as the offending companies is made the target of attack. Certainly some of the attackers have political axes to grind, but the net result is antagonistic feeling stirred up against the commission. A rather full realization of this situation led the Illinois commission to attempt to alleviate it by inducing the utilities to adopt more modern methods of handling all complaints. As a part of this plan a letter was written to all utilities appealing for the installation of complaint-handling methods that would impart individuality to each complaint.

The results of these letters as a whole have been satisfactory in that most of the utilities expressed themselves as in accord with the suggestions of the letter. Some of them have been rather unsatisfactory because the correspondent has assumed that the duty rested with him to assure the commission that the policy of the company was in accord with that expressed in the letter rather than to give the matter any really serious consideration. Many of the utilities stated that they were having copies of the letter made for circulation among their employees and for posting in the office where the employees meet the public. Some of the larger utilities make it a practice to have all letters of complaint transmitted to a responsible executive of the company for perusal, which is certainly a very full and complete application of the principles set forth in the letter.

Practically all of the replies received were from the larger companies, and, as one would anticipate, the companies which already have the most satisfactory methods of dealing with their consumers are those to which the letter made the strongest appeal. The commission deserves credit for its keen analysis and for having devised a means for helping its own position while it was at the same time assisting the companies to a better understanding of their responsibility in matters of public policy.

The use of practical problems in teaching mathematics points the way toward an improvement in educational technique long needed in the training of engineers. Facility in the use of mathematics as a valuable tool in engineering practice is essential in much advanced work, and the edge of this tool should not be dulled by rubbing too many abstractions into the impressionable mind of the undergraduate.

Lighting a Small City

THE street-lighting plan of a city should always be, but seldom is, arranged with reference to the real requirements of the situation. There is a frequent tendency to put up cheap imitations of the systems that are appropriate only to the stately streets of a genuine metropolis. As a result we often see "white ways" that bring out in grotesque relief the shabby fronts of second-rate buildings and have no suggestion of gayety or magnificence save as they bear garish witness to the colossal and hypnotic nerve of the fixture salesman whose zeal outran his better judgment. It is a pleasure, therefore, to record a case where means were judiciously adapted to ends and a city was given street lighting of a character at once suitable, finished and efficient.

The problem that confronted C. D. Gray and E. Hagenlocher, an account of which is printed elsewhere in this issue, was a simple one in principle but required no small amount of work for its solution. It was the complete reorganization of the street illumination of a small city of the better class where a badly run and obsolescent arc system vied with a rather worse series incandescent system in the race for inefficiency. All concerned joined in wanting improvement, and they assuredly got it. The general principle followed was to settle upon a standard form of prismatic refractor worked out as a lantern with frosted bowl. In these lanterns, waterproof, neat in appearance and efficient, were installed such modern series incandescent lamps as the situation demanded, from 250 cp. to replace the ancient arcs down to 100 cp. and 80 cp.

Double-fixture poles were adopted at a standard height of 15 ft., and these were spaced oppositely every 100 ft. in the more important business districts and alternately in residence streets. In the former situation reducing transformers kept the voltage to 300 per circuit in the interest of safety and ease of handling. In outlying districts, where the ornamental fixtures were unnecessary, refractors were still installed and new brackets put up. The net result was a very great improvement both in appearance and efficiency. The energy spent was very modest, but the lamps were worked to their full intensity and the refractors gave them the carrying power that a bare lamp lacks.

Vacuum-Tube Amplifiers

Weak Telegraphic Ground Currents and Stray Telephonic Currents Are Detected by the Use of Vacuum-Tube Amplifiers—Both Radio and Audio Frequency Signals Are Amplified, and Sensitive Direction Finding Is Made Possible

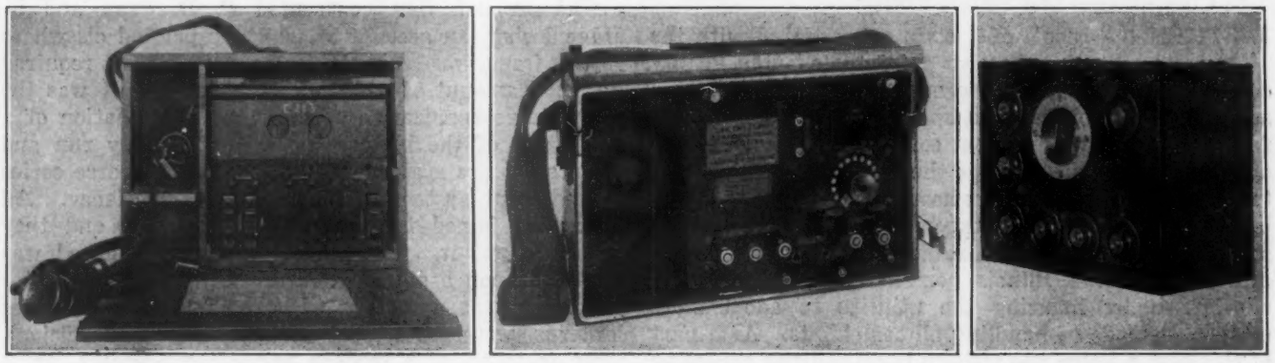
BY LIEUT. MAX C. BATSEL, SIGNAL CORPS, U. S. A.

THE most fundamental and most useful property of the vacuum tube is its ability to amplify alternating electrical currents, voltages or power. This amplifying ability arises from the fact that the power required to cause a given variation in the potential of the grid of a tube is less than the power associated with the resulting variations of the current in the plate circuit. The Signal Corps of the United States Army has made two important uses of vacuum-tube amplifiers, for the amplification of weak ground currents in the reception of earth conduction telegraph signals and the picking up of stray telephonic currents, and for the amplification of radio signals both at radio frequency before being rectified by a detector and at audio frequency after the radio-frequency signals are changed to an audible frequency by means of the detector.

Although a vacuum-tube amplifier, in a sense, returns more energy than it receives, amplification does not violate the principle of the conservation of energy and does not literally give something for nothing. It may be likened to the action of an ordinary direct-current generator. An increase in the field current (or voltage) of the generator will cause a similar increase in the voltage produced by the armature and correspondingly in the load current. The increase in output will be much greater than the increase of power in the field circuit, but this added power is, of course, derived from mechanical forces which drive the generator shaft. In an analogous sense, the amplified power derived from a vacuum tube is obtained from the battery which supplies the plate voltage and current of the tube. In the generator the field voltage controls the output through the agency of a magnetic field. In the vacuum tube the grid voltage controls the output through the agency of an electric field.

When the grid of a tube is maintained at a mean potential more negative than any part of the filament the only current which flows in it is a very small one due to leakage or gas ionization. Therefore the amount of power required to cause a given change in the grid potential is small. Since the vacuum tube operates by virtue of the potential difference established between the filament and grid, it is desirable to transform the power supplied to as high a voltage as possible. If the source of voltage has an impedance Z_1, a transformer to supply current to the grid filament circuit should have a ratio K in the step-up sense such that $K^2Z_1 = Z_2$, where Z_2 is the impedance of the grid filament circuit. The maximum power is then derived from the source of voltage, and the greatest possible potential difference established between the filament and grid, resulting in the maximum power output from the tube. Such a transformer is known as an "input transformer," and its use with vacuum-tube amplifiers is almost universal. The combination of input transformer and tube is called one "stage" of amplification. Several stages may be connected in series or cascade, the plate circuit of one tube feeding into the primary of the input transformer of the next stage, and so on.

The problem of the design and construction of amplifiers, aside from the tubes themselves, is almost entirely one of obtaining suitable and efficient input transformers and of arranging various parts so as to avoid any coupling effects between input and output. Avoidance of magnetic or electrostatic coupling between input and output circuits is essential because such coupling results either in a decrease in amplification or in persistent howling, depending upon whether or not the impulse fed back from output to input opposes or assists the input impulse.



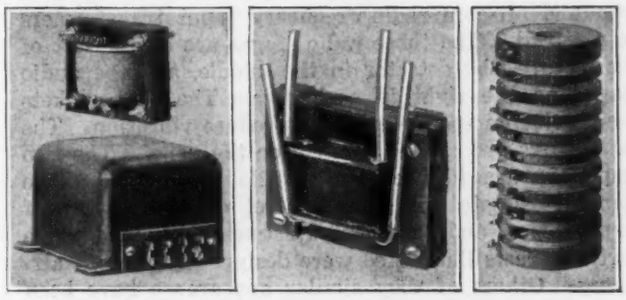
FIGS. 1, 2 AND 3—DEVELOPMENT OF AMPLIFIER SETS—LIGHT-WEIGHT SET AT RIGHT (WEIGHT 8 LB.)

The amplifier has been looked upon by the Signal Corps as an auxiliary device employed for the purpose of obtaining louder signals in a telephone head set. To be successful it must, therefore, be a simple, self-contained outfit requiring no attention or adjustment on the part of the operator other than the replacement of run-down batteries or burned-out tubes. The first audio frequency amplifiers were designed and built for the Signal Corps by the Western Electric Company. Signal Corps engineers have developed improved input transformers for such amplifiers and have carried out

all of the development and design of amplifiers for use at radio frequencies.

AUDIO FREQUENCY AMPLIFIERS

One of the first pieces of radio equipment manufactured for the army after the establishment of the radio development organization was the type SCR-72 two-stage audio frequency amplifier designed and constructed by the Western Electric Company. Many hundreds of them were produced and have in service given excellent satisfaction. An SCR-72 set is shown in Fig. 1. The amplifier box proper, which contains the transformers, tubes and plate-circuit dry battery, is carried in a compartment of an outside case, which also has compartments for telephone head sets, spare tubes and batteries, connecting cord for storage battery, etc. On the amplifier box binding posts are provided for connecting to the input and to the 4-volt storage battery which heats the filament of the tubes. Telephone jacks are arranged so that the head set can be connected direct to the "input" or to the "output" of the first or second stage. There are no adjustments of any kind. Simplicity and reliability are the outstanding features. The power of the output signal is from 40,000 to 60,000 times that of the input signal.



FIGS. 4, 5 AND 6—INPUT TRANSFORMER DESIGNS FOR AMPLIFIERS

Audio frequency transformers (left); iron-core and air-core types (right).

The test of practical use showed that several minor modifications of the SCR-72 would improve its usefulness, and after sufficient practical data had been collected a redesign was made by the Western Electric Company which resulted in the SCR-72-B, illustrated in Fig. 2. Improved accessibility, more convenient arrangements for connections and decreased weight were obtained, and a variable shunt was added to the telephones for controlling the degree of amplification. The inner separate case was eliminated and everything mounted directly in one case. The amplification control by rather small steps proved necessary on account of the peculiarities of the human ear. If the signal to be received is weak and is masked by interfering noises of equal or greater loudness, it is found that amplification beyond a certain degree is detrimental. If the interfering noises are amplified to be louder than this rather critical value, the ear is overburdened and is unable to distinguish the signal as well as when both signal and interference are weaker.

More recently there has arisen a demand for a very small and light amplifier for miscellaneous uses. The amplifier shown in Fig. 3 was designed by the Signal Corps to meet this need. It utilizes the miniature transformers described in later paragraphs and carries no spares, cords or telephone headsets. It is, however, a complete set containing tubes, transformers and plate-circuit dry batteries. It is arranged so that the first tube may be used as a radio detector in order that the set may be either a two-stage amplifier or a detector and one-stage amplifier. When supplied with 4-volt storage battery and telephone headset it is ready for use. The dimensions are 9½ in. by 7⅜ in. by 4½ in. (23.1 cm. by 18.7 cm. by 11.4 cm.), and the weight is 8 lb. (3.6 kg.).

The input transformer which was used in the SCR-72-B amplifiers and in certain other equipment which involved stages of amplification as built in units was designed and manufactured by the Western Electric Company. It is a shell-type transformer, and its winding is composed of about 6000 ft. (1830 m.) of No. 40 enameled copper wire covered with a single layer of silk. The placing of orders with various manufacturers, which involved the construction of a total of nearly 40,000 of these transformers, revealed the fact that on account of the difficulty of manufacture and the scarcity of silk it would be impossible to obtain sufficient wire. Signal Corps engineers therefore attacked the problem of a substitute winding. The efficiency of the transformer depends largely on the reduction of turn-to-turn capacity, and enameled wire alone could not be used although the supply was ample. In cooperation with the Dudlo Manufacturing Company a sectionalized winding was developed using No. 40 enameled wire with paper insulation between layers. This winding is not only as efficient as the previous one but is considerably cheaper.

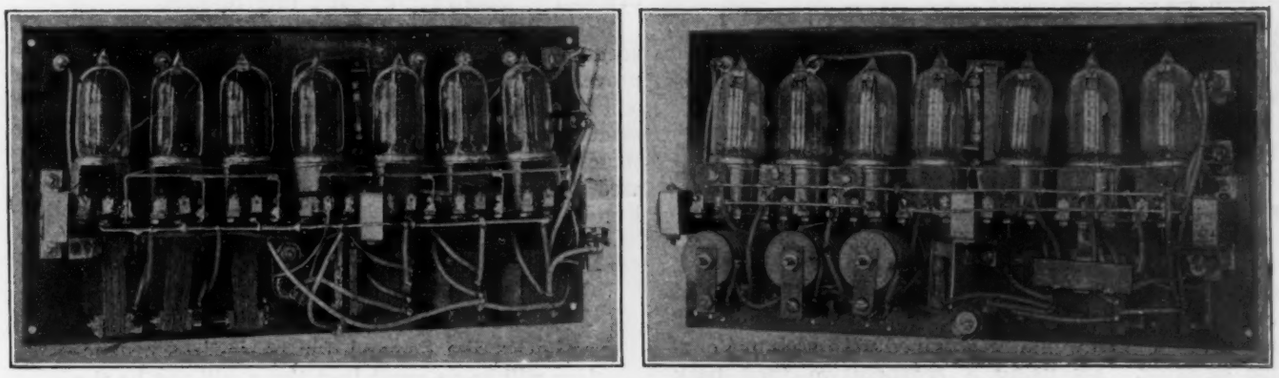


FIG. 7 AND 8—SEVEN-TUBE RADIO-AUDIO FREQUENCY SETS

Audio stages at right; radio stages at left. Note the use of air-core input transformers in Fig. 8

The type of transformer described above, either with silk or paper insulation, is a very efficient one from the

electrical standpoint and produces negligible distortion in telephonic currents. It is, however, large and heavy, and the addition of two or three of them to an airplane set or a set designed to be carried on the back of a soldier in the field is a serious thing, since in such equipment every possible ounce must be eliminated. After a considerable amount of experimental investigation the Signal Corps engineers have designed a much smaller and lighter transformer which is fully as satisfactory in its electrical characteristics and is in addition easier and cheaper to manufacture. The old and the new types are contrasted in Fig. 4. The former weighs 2 lb. (0.9 kg.) and the latter 7 oz. (0.2 kg.).

RADIO FREQUENCY AMPLIFIERS

The development work on radio frequency amplifiers has been carried out entirely by Signal Corps engineers assisted in its initial stages by information gained from the French and British. The principal use to which these amplifiers have been so far applied is in connection with radio direction finders. In this work the signals are generally so weak (and thus the amount of energy picked up by the small loop antenna is so meager) that extremely high amplification must be employed. To build a reliable, efficient amplifier of more than three stages, at any one frequency, is practically impossible, since very grave difficulties are met with in keeping it from howling or oscillating. It is, however, quite feasible to amplify a radio signal at its radio frequency, pass it through a detector tube and then amplify the resulting audio frequency current. This not only gives the increase due to both the radio and the audio frequency amplifiers, but in addition increases the detector tube efficiency since, within limits, the efficiency of detection increases with the signal strength. Thus the receiver usually works out best in seven stages —three radio, one detector and three audio. Properly

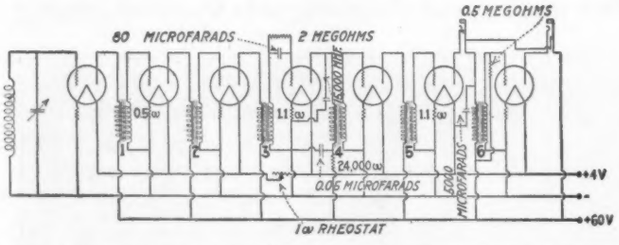


FIG. 9—DIAGRAM OF CONNECTIONS FOR SEVEN-STAGE AMPLIFIERS—LOW-FREQUENCY TRANSFORMERS AT RIGHT

designed sets of this kind, operated non-oscillating and without regeneration, will give signals more than 10^{14} times as strong as would be obtained with a simple one-tube detector. By using a regenerative feed back much higher amplification can be realized but the operation becomes less stable.

Of the several methods which may be used for transferring the output of the plate circuit of one tube of a radio frequency amplifier to the input or grid circuit of the next tube, the iron-core input transformer has been most used. Air-core transformers have also been successfully utilized, but they result in a less stable unit. A picture of an iron-core radio frequency input transformer is shown in Fig. 5. The core is made up of laminations of enameled soft steel 1½ mils thick (0.38 mm.). The primary and secondary windings each consist of a single layer of No. 40 enameled copper wire. The magnetic circuit contains a short air gap. The transformer is approximately the same size as the small audio frequency one and is somewhat lighter. The air-core transformer illustrated in Fig. 6 consists of several pancake windings on a grooved spool of insulating material. Alternate coils are connected in series, one set being primary and the other secondary.

Figs. 7 and 8 show rear views of the panels of seven-stage radio-audio frequency amplifiers made up with iron and air-core radio frequency input transformers respectively. The three radio stages are on the left of the picture, the detector in the middle, and the audio stages on the right in each case. The tube sockets are carried on sponge rubber to reduce vibration. The other parts are carried directly on the panel. The two amplifiers are identical in outside appearance. The filament rheostat provides control of the degree of amplification, and no other adjustment is needed. The particular sets illustrated were designed for use in airplanes. Others of very similar appearance have been made for ground use. The circuit diagram is shown in Fig. 9. The batteries for supplying the plate current are contained in a separate box. It is desirable to have the amplifier box as small as possible because it is more convenient to mount several small boxes in an airplane than one large box. The plate battery consists of three standard 20-volt dry batteries in series. The filament battery must supply 7.7 amp. at 4 volts.

The following radio engineer officers of the Radio Laboratories have contributed effectively to the development of the radio frequency amplifiers: Second Lieut. James M. Cork, Signal Corps, and Second Lieut. Leon T. Wilson, Signal Corps.

The utility of radio frequency amplification in connection with the highly important art of radio direction finding has been demonstrated. It is highly probable that it will find other equally important applications. The high selectivity obtained, together with ability to make easily audible extremely faint radio signals, marks it as a promising aid toward the final solution of the problem of eliminating static interference.

With further development of improved types of vacuum tubes there is certain to be a corresponding improvement in amplifiers. The sizes of the vacuum tubes and the amount of power required for heating the filaments may be reduced, thus making it possible to construct very small, light amplifiers which can be operated with a dry cell for heating the filaments.

I AM of the opinion that from the time we restore ourselves to our normal post-war activities the demand for peace-time production will be so great that there will not be the remotest possibility of securing any reduction in the wage rates from their present basis. I feel further that the manufacturer who fails to take into consideration the prospects of the future, and who, in a hope of securing cheaper labor or cheaper raw material, does not build up his organization and maintain it during the possibly brief period of readjustment, will be handicapped in securing his share of the business afterward; because he will be handicapped through lack of working forces in his factory. —*William B. Wilson, Secretary of Labor.*

Design of Small Direct-Current Armatures

A Method of Systematically Designing Small Armatures Is Presented Based Upon Both Test Data and Theory Developed for Larger Machines—Progress Has Been Limited by Lack of Experimentation

BY C. R. WYLIE
Consulting Engineer, formerly Director Research Laboratory of the Remy Electric Company

CO-OPERATION, standardization and efficiency are the issues every one must face squarely and promote intelligently during the long period of reëstablishment which has already begun. Electricity is going to serve as one of the greatest industrial agencies in the stabilization of economic conditions, and the electrical profession must prepare to shoulder its approaching responsibility. Chief among the applications of electricity in the revitalizing of industry should be the universal electrification of machinery and all motive processes. The day of the small motor would seem to be at hand, yet many of the smaller machines on the market are by actual test found to have much less excellent characteristics (*i.e.*, efficiency, weight and cost as related to capacity) than they could be made to have. This may mean that the small dynamo is produced too often by imitation.

Problems in Manufacture of Small Dynamos

In the manufacturing of small dynamos the same completeness of individual testing of the finished product as is necessary for large machines can hardly be afforded. For instance, individual heat runs in small factories are out of the question. However, there should be some attempt at general supervision in the matter somewhere between the designer and the customer. Heat runs should at least be made from time to time on typical machines. It is possible for the designer to calculate from the known properties of his iron and his copper the total watts lost as heat in the armature under load conditions. Standardized manufacture and investigative testing will show how many watts per square inch of armature surface is allowable for safe operation of each size of machine produced. Thus rational ratings may be established. The rating is naturally a function of the ventilation, friction and the durability of insulation, copper, etc., and hence of the size and speed of the machine.

In the designing of direct-current dynamos the basic problem is the dimensioning of the armature. When once the dimensions of this part of the machine, the number of slots and the required flux are known, then it is a comparatively easy matter to determine the field winding, dimensions of the magnetic circuit, etc. Consideration of the armature cannot be, however, altogether independent of the field details. Under some conditions, of course, the details of the whole will have to be "jockeyed" somewhat until the most satisfactory combination is found.

It is the purpose of this paper to review the basis for the standard procedure in armature design and to furnish data providing for the application of these principles to the smaller machines similar to the data published by Gray and others for large machines. It is hoped that this article may stimulate interest in the small dynamo among writers and in the trade.

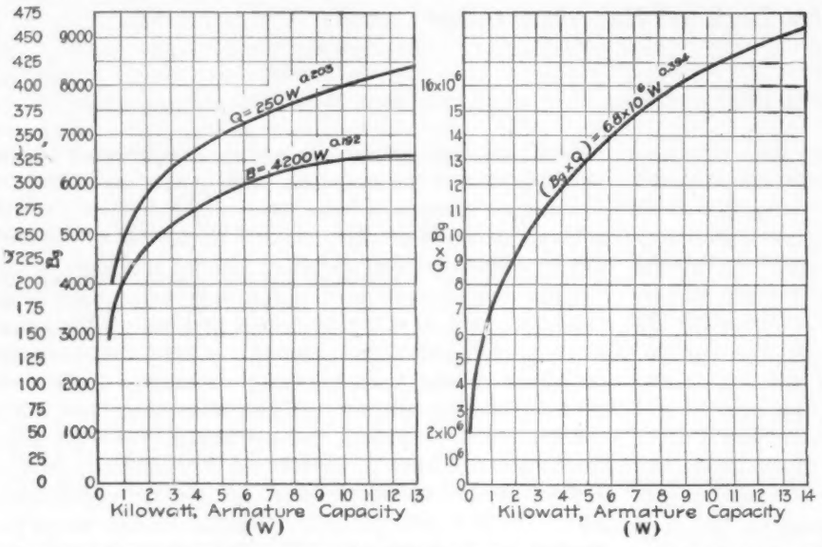
The data presented have been established by analytical consideration of the magnetic properties of present-day armature iron of excellent quality and checked by the observed properties of about a dozen modern high-class machines of different makes and within the range considered. The data, it must be kept in mind, are definitely related to the magnetic quality of the iron used in the armature core. The curves submitted imply the best iron in use at the present and assume good ventilation and careful mechanical construction. Where a poor grade of iron is used for the armature core, where the laminations are thicker than usual, where the mechanical features are such that undue heating by friction results, or where the machine is to be operated inclosed, a suitable margin will have to be allowed in selecting values from the curves. On the other hand, as the materials used in the construction of armatures are improved the curves will become more and more conservative and ultimately, it may be expected, will require elevation.

Basic Design Data

The limitation to the capacity of the armature of a dynamo (motor or generator) is the heating that may be safely allowed. The heating of an armature results from the armature copper loss ($I^2_a R_a$), the two core losses (hysteresis, $W_h = k_h f \beta^{1.6}_{max}$, and eddy currents, $W_e = k_e t^2 f^2 \beta^2_{max}$), bearing and brush friction and heat transferred from the field. If the sum total of these effects is such that the ventilation to be obtained provides for the dissipation of the heat generated at a rate such that the ultimate rise of temperature may be considered as not endangering the insulation, then the corresponding load conditions may be considered as a proper rating for the machine. Consideration of these matters makes it evident that the efforts of the designer must comprehend as a composite aim: (1) the reduction of the resistance of the armature to a minimum; (2) the use of the best magnetic iron, *i.e.*, that which has the lowest hysteretic and eddy current constants; (3) mechanically excellent bearings and minimum heating of the commutator; (4) excellent ventilation; (5) minimum heat loss in field; (6) the most durable insulating material with due regard to mechanical and electrical requirements, and (7) at the same time the ultimate cost must be kept within economic limits.

Obviously the joint influence of the various factors involved in heating an armature can be properly regarded only by the use of one or more empirical constants. Core losses and copper loss produce by far the greater part of the heating; ventilation and mechanical friction can be pretty well standardized. Thus a suit-

able method of supervision may be based upon empirical flux density and specific copper loss as a function of the required armature capacity. Such factors can be approximated by the application of thermal principles and the consideration of the properties of magnetic iron, checked by data deduced from experimental observation of high-class machines already constructed. Curves exhibiting values obtained in such manner have been constructed; they appear as Fig. 1. Fig. 2 is a composite of the two curves of Fig. 1.



FIGS. 1 AND 2—EMPIRICAL CONSTANTS FOR USE IN THE DESIGN OF SMALL ARMATURES

(1) Loading factor (amp. cond. per in.) and average air-gap flux density (gauss) as a function of armature capacity.
(2) $Q \times Bg$ as a function of armature capacity, Q = amp. cond. per in. Bg = air-gap flux density, maxwells per square inch.

Before the curves can be satisfactorily understood and utilized the manner in which the empirical factors relate themselves to the armature dimensions must be determined. A simple analysis based upon the fundamental equation of the generator leads to this understanding showing how the volume of the armature is a function only of capacity, speed and these constants.

The fundamental equation for the direct-current dynamo is familiar. **It is:**

$$E_a = \frac{\varphi Z N P 10^8}{60 p} \qquad (1)$$

Here:

E_a = the generated emf. in volts (back emf. in the case of the motor).
φ = the magnetic flux in maxwells.
Z = the total number of inductors about the periphery of the armature.
N = r.p.m.
P = number of poles
p = number of paths in parallel in the armature winding.

Since the designer knows the capacity, speed voltage and type of winding for a given machine before he seeks to determine dimensions, the electrical capacity of the armature in watts may be written:

$$W_a = pE_aI_p \qquad (2)$$

where I_p = the current in amperes per armature path. Let it be assumed that B_g is the average flux density in the air gap in maxwells per square inch (apparent air-gap flux density), and let L_a be the length of the armature in inches and D_a its diameter in inches; then:

$$\varphi = B_g L_a \frac{\pi}{P} D_a \rho \qquad (3)$$

Where:

$$\rho = \frac{\text{pole arc}}{\text{pole pitch}} = 0.7 \text{ on the average.}$$

Substituting (3) in (1):

$$E_a = B_g L_a \frac{\pi}{P} D_a \rho Z \frac{N}{60} \frac{P}{p} 10^{-8} \qquad (4)$$

Then substituting (4) in (2)

$$W_a = E_a I_p p = B_g L_a D_a \pi \rho Z \frac{N}{60} I_p 10^{-8} \qquad (5)$$

It is certainly true that the amount of allowable armature current is related to the size of the armature and the number of inductors because of the limit to the heat that can be safely radiated per square inch (with standard insulation and good ventilation). The copper loss is proportional in any given machine to the number of inductors, and the amount of heat loss allowable is proportional to the radiating surface of the armature. In other words, heating is proportional to CZI^2_p, and the heating per square unit of surface may be taken as an index for the acceptable armature capacity.

The radiating surface of an armature comprises the cylindrical surface and the two irregular ends. It is safe to assume that the increased surface in the ends over that of the projected cross-section of the armature corresponds approximately to the increased lengths of wire.

Hence, since heating is proportional to the length of wire, the amount of heat to be radiated may be considered as independent of the shape of the ends of the arma-

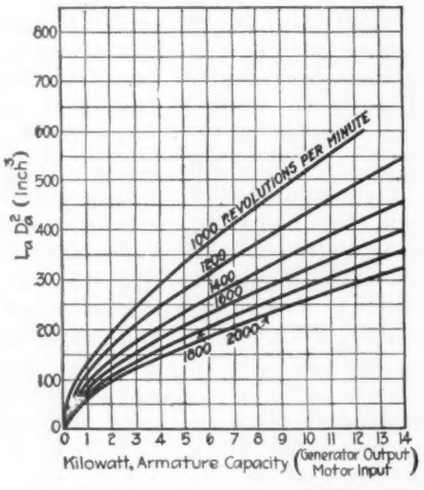


FIG. 3—VARIATION OF $L_a D_a^2$ WITH ARMATURE CAPACITY AND SPEED
Based on Fig. 1. = 0.7

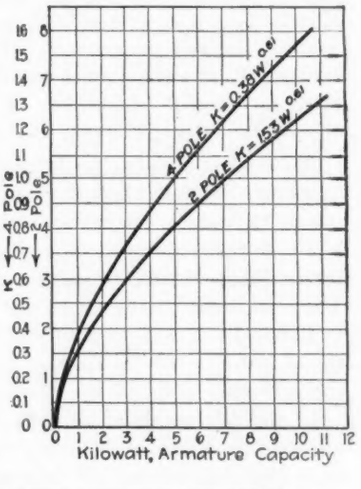


FIG. 4—VARIATION OF CONSTANT K WITH ARMATURE CAPACITY AND NUMBER OF POLES

From equation $L_a = \sqrt[3]{\frac{K \times 10^8}{N}}$.

ture. In other words, the total radiating surface may be considered as

$K_1 \times$ cylindrical surface of armature $= K_1 \pi D_a L_a$,

and the total heating as:

$K_1 \times$ heat generated in the inductors $= K_1 Z R_z I_p^2$.

Thus the heating per square inch may be written:

$$\frac{k_1 Z R_z I_p^2}{k_1 \pi D_a L_a} = \frac{Z I_p}{\pi D_a}\left(\frac{R_z I_p}{L_a}\right)$$

$R_z I_p$ is clearly the potential drop in each inductor. R_z is proportional to the length of the armature L_a; hence:

$$\frac{R^z I_p}{L_a} = \frac{k L_a I_p}{L_a}$$

This expression will be constant for a given machine and will depend upon the specific resistance of the copper used. Calling such constant K_z, the heating per square inch becomes:

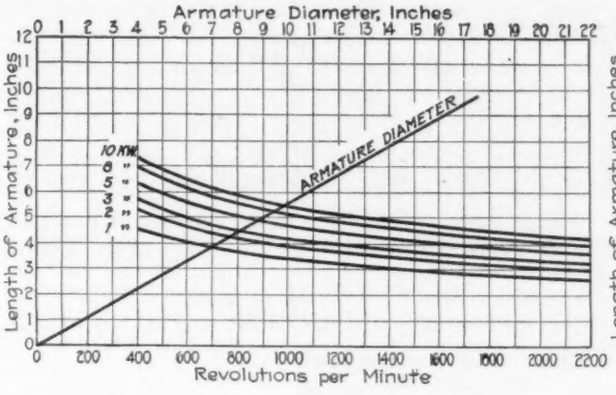
$$H_a = K_2 Z I_p / \pi D_a;$$

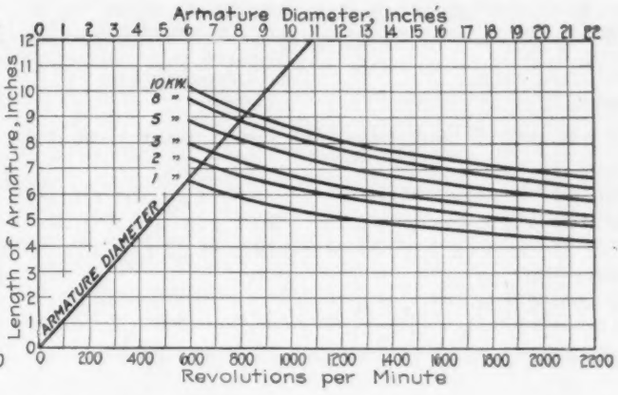
or

$$H_a / K_2 = Z I_p / \pi D_a.$$

H_a/K_2 may be regarded as definitely related to the size of a machine, since H_a, the allowable heating per square inch of radiating surface, is established by practice in relation to dimensions, ventilation and durability of insulation.

H_a/K_2 is thus a specific constant depending upon the length and specific resistance of the copper, specific core losses for the iron used, ventilation and insulation. It may be approximated by investigation.





FIGS. 5 AND 6—ARMATURE LENGTH AS A FUNCTION OF SPEED ($\rho = 0.7$)

Fig. 5—For four-pole machine $L_a = \frac{33.6\ W^{0.203}}{\sqrt[3]{N}}$, $D_a = \frac{L_a}{0.55}$.

Fig. 6—For two-pole machine $L_a = \frac{53.5\ W^{0.203}}{\sqrt[3]{N}}$, $D_a = \frac{L_a}{1.1}$

Calling

$$\frac{H_a}{K_2} = \frac{Z I_p}{\pi D_a},\ Q, \qquad (6)$$

and substituting in (5):

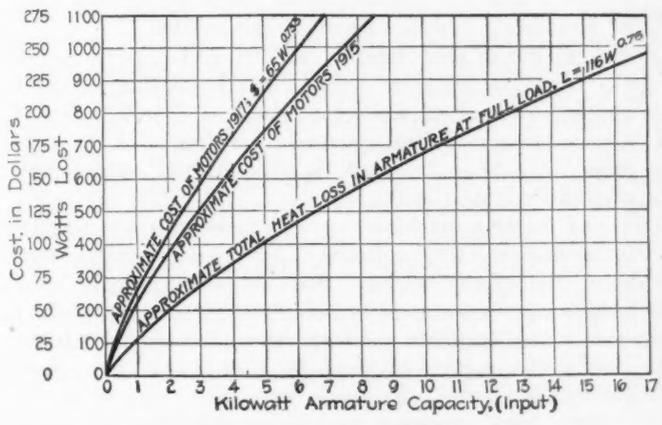
$$W_a = B_g Q L_a D_a^2 \pi^2 \rho \frac{N}{60} 10^{-8} \qquad (7)$$

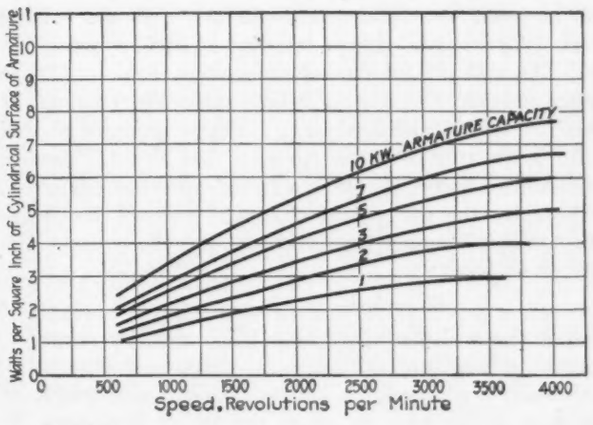
$= B_g Q L_a D_a^2 N 1.15 \times 10^{-9}$ (when $\rho = 0.7$)

$= B_g Q L_a D_a^2 N 7.42 \times 10^{-9}$ (where B_g is in gauss).

The amount of heating to be allowed per square inch of radiating surface must of course be less in small machines than in large. Also the eddy current losses and hysteresis tend to be greater in proportion to capacity on smaller machines. So Q and B_g increase as the capacity of armatures increases.

On the basis that the analysis here reviewed may be satisfactorily applied to the design of direct-current armatures ranging from 1 kw. to 10 kw. in rating, values for B_g and Q have to be deduced. As noted before, this work may be done theoretically or it can be accomplished by studying the properties of various high-class machines of modern type (those which upon test show excellent efficiency and consistent rating).


Cost in Dollars
Watts Lost
Kilowatt Armature Capacity, (Input)
APPROXIMATE COST OF MOTORS 1917; $ = .65 W^0.75
APPROXIMATE COST OF MOTORS 1915
APPROXIMATE TOTAL HEAT LOSS IN ARMATURE AT FULL LOAD, L = 116 W^0.75



FIGS. 7 AND 8—ARMATURE LOSS AND COST OF SMALL MOTORS

Fig. 7—Shunt motors, 1200 to 1800 r.p.m., 115 volts.

Fig. 8—Safe allowable losses.

An example of the second method as used in preparing the curves follows:

Machine Data:

Make, T—— E—— Co.	Arm. diam., 8¾-in.
Type, D.-C. shunt.	Arm. length, 4¾ in.
Capacity, 7½ hp.	Arm. inductors, 252.
Output, 5 kw.	Arm. res. ————
Speed, 1100 r.p.m.	Arm. capacity, 6 kw.
Voltage, 125.	$\rho = 0.7$.

At normal full load the efficiency was found to be 82 per cent.

The rise in temperature at the surface of the armature after six hours' run at full load was found to be 35 deg. C. from an initial temperature of 22 deg. C.

Determination of $B_g \times Q$:

From equation (7) of analysis

$$B_gQ = \frac{W_a \times 10^9}{1.15 \times L_a \times D_a^2 \times N} = \left(\frac{5\ 00}{0.82} \times 10^9\right) \div [1.15 \times 4.75 \times (8.75)^2\ 1100] = 14 \times 10^6$$

for B_g in maxwells per square inch.

Determination of Q: Number of slots = 63; number of conductors per slot = 252/63 = 4; periphery = 8.75π = 28 in.; ampere conductors per inch = (252 × 40)/28.0 = 360 = Q. B_g then may be deduced as: $14 \times 10^6/360$ = 39,000 maxwells per square inch = 39,000/6.45 = 6050 gauss.

Other points are checked by similar study of the selected dynamos.

The curves in Fig. 1 exhibit the determined values for B_g and Q as functions of the capacity. When plotted on logarithmic paper these curves give straight lines. Empirical equations were thus readily obtained for the range studied. These are:

$$B_g = 4200\ W^{0.192} \quad (8)$$

$$Q = 250\ W^{0.203} \quad (9)$$

$$B_gQ = 6.8 \times 10^6 W^{0.394} \quad (B_g \text{ maxwells per sq.in.}) \quad (10)$$

This last equation is that shown graphically in Fig. 2.

It is evident from equation (7) that the capacity of an armature is a function of speed (N) and volume ($L_aD_a^2$).

From a consideration of Fig. 2 and equation (7) curves were calculated and plotted showing the relationship between size of armature in kw. and the volume index ($L_aD_a^2$) for varied speeds for polar arc ρ = 0.7). This family of curves appears in Fig. 3. These curves provide for finding what value the product of armature length and armature diameter squared should be for a dynamo of given capacity and speed. Having found such a value, it remains to separate the variables.

Evidently the peripheral circumference of the armature times 0.7 equals the length of pole face times the number of poles; *i.e.*,

$$C = \pi D_a = (L_{pole\ face}P)/0.7.$$

Since the width of pole face $W_{p.f.}$ may be regarded as equal to length of armature L_a, there need only to be established a relationship between length and width of pole face to be able to state length of armature in terms of its diameter. The ratio $W_{p.f.}/L_{p.f.}$ varies with different manufacturers and with different sizes of machine. Practice, however, shows that on small dynamos a ratio of 1 is in the end the most economical. This assumption is made in the present analysis. Thus:

$$D_a = PL_a/\pi\rho.$$

Inserting this value of D_a in equation (7) and solving for L_a:

$$L_a = \frac{W_a\pi^2\rho^2 60}{B_gQL_a^2P^2\pi^2\rho N}10^8$$

Whence.

$$L_a^3 = \frac{W_a\rho 60}{B_gQP^2N}10^8$$

and

$$L_a = \sqrt[3]{\frac{W_a\rho 60}{B_gQP^2N}}10^8. \quad (11)$$

With a given value of ρ, a given number of poles and a given armature capacity, length of armature depends only upon the speed; *i.e.*:

$$L_a = \sqrt[3]{K/N} \quad (12)$$

Where K is the combined value,

$$\frac{W_a\rho 60}{B_gQP^2}10^8.$$

ρ was taken as 0.7 and for successive values of W_a, ($B \times Q$) was taken from Fig. 2 and combined with 60×10^8 to give K as a function of armature capacity. Data for both two-pole and four-pole armature were calculated and curves plotted. These appear in Fig. 4.

In Fig. 5 is given a family of curves exhibiting directly the length of armature as a function of speed for any capacity of armature for four-pole dynamos. The data for these curves were calculated by substituting the proper values for K (as shown in Fig. 4) in equation (12).

Fig. 6 gives the corresponding family of curves where the machine is bipolar.

The total heat loss curve in Fig. 7 gives typical values for the copper and core losses in different-sized armatures. The curve was plotted with data secured from tests made on the motors studied in the preparation of this paper.

The remaining two curves in Fig. 7 show the approximate cost of small dynamos during 1917 and during 1915. The data were obtained from quotations, manufacturers' price lists and from a number of actual transactions. These curves are of interest in indicating prices which the manufacturer must reckon with in putting high-class machines in the market.

A factor of considerable interest and importance to the armature designer is the allowable heating in watts per square inch of radiating surface. The handbooks give various empirical constants varying with the size, speed, etc., from 0.5 watt to 10 watts per square inch of total radiation surface.

The faster a machine runs the more effective will be its radiation (within limits), and the larger the machine the more the heat that may be allowed to be radiated per square inch of surface. However, no data seem to be available showing reasonable values graduated with respect to capacity and speed for small armatures.

It has been attempted, in the curves of Fig. 8, to provide such data. These curves show heating densities suitable for well-built, well-ventilated dynamos. Since it is often hard to decide upon the total radiating surface of an armature, the values have been established in terms of the cylindrical armature surface, which area can be obtained definitely in every case.

Methods and formulas based upon the theory of heat radiation, conduction and convection have been developed by various investigators expressing the degree of temperature rise of armatures in terms of dimensions, peripheral velocity and room temperature. The writer has tried to reconcile values computed by the use of such methods with the actual performance of small motors without any measure of success. As a result methods somewhat tentative were used in locating the curves of Fig. 8. The curves were constructed from combined data supplied by four methods of analysis:

1. Selection of consistent values calculated by use of theoretical formulas.
2. Calculation by use of the total heat-loss curve of Fig. 7 in conjunction with armature dimensions taken from curves in Fig. 5.
3. Calculation from measured dimensions and the calculated heat loss of actual machines.
4. Calculation from measured dimensions and the resulting data from actual heat runs on a number of motors.

These curves are offered as exhibiting the approximate allowable heat in watts per square inch of cylindrical armature surface for armatures of different capacities and different speeds. The basis for the plotting of the curves, it is readily seen, precludes the assumption that the values read therefrom represent a standard temperature rise. But, being based to a large extent upon data from high-grade machines giving satisfactory service, they represent safe heating values. In plotting, the curves were deliberately lowered a little in the smaller sizes at the lower speeds, in order to be conservative. On the other hand, heat-run data indicated that at the higher speeds and in the larger sizes the temperature rise within the core may be as much as, if not more than, 50 deg. C. It is believed that the curves may be regarded as corresponding to an approximate temperature rise of 40 deg. C. above a room temperature of 25 deg. C. for the smaller machines at lower speeds and gradually increasing to a maximum temperature rise of about 50 deg. above a room temperature of 25 deg. C. for the larger machines at the higher speeds.

These curves, taken together with the total-heat-loss curve of Fig. 7, will be found useful in checking up the performance of dynamos designed from the data given in the preceding curves or in selecting armature dimensions where it is desired to deviate from the values given by the design curves.

Street Lighting in a City of Average Size

Features of Ornamental System Installed at South Norwalk, Conn., with Small Initial Cost and Operated with a Low Maintenance Expense—Excellent Illumination Obtained with Simple Fixtures Which Assure Safety

BY C. D. GRAY AND E. HAGENLOCHER
of the J. G. White Engineering Corporation

AT SOUTH NORWALK, Conn., is a rather novel street-lighting system the building of which involved the solution of problems that are of vital interest to a large number of small cities where good and ornamental lighting is desired at a small initial cost and low maintenance expense. The layout chosen was selected after a study of many existing installations had been made in which it was found that equipment of the desired characteristics was not available on the market. Special diffusing and refractory glassware, together with a modification of a standard fixture and a bracket, was designed and used in this installation. This equipment is now available in a standard form.

The old system consisted of arc and incandescent lamps supplied by two 5-amp., 5000-volt circuits which received their current from a Thomson-Houston brush-arc machine. Owing to the difficulty of obtaining incandescent lamps rated at 5 amp. it was necessary to use standard lamps built for 5.5-amp. circuits, which, of course, gave low intensity of illumination. Another factor which still further decreased the illumination was that trouble with the windings of the arc machine reduced its capacity so that the circuits were supplied with only 4.8-amp. and 4.9-amp. respectively. The result was that the total effective illumination was reduced about 50 per cent from what should have been expected from the candlepower rating of the lamps. The 5-amp. arc lamps received more nearly their rated current than the incandescents but did not operate satisfactorily.

The first step toward improvement was the installing of three constant-current transformers rated at 15 kw. each and arranged so that one would be a spare and each of the others would supply two 6.6-amp. circuits. The old arc lamps were removed and replaced by 250-cp. power incandescent lamps with prismatic-band refractors mounted on temporary brackets. All the old incandescent fixtures were fitted with 6.6 amp. lamps. The change-over from the old arc machine to the constant-current transformers was made without any interruptions in the street lighting by taking one circuit at a time. The increase in the illumination was very noticeable, owing to the candlepower of the lamps being brought up to normal.

Lamp Fixtures.—The type of fixture employed is a product of the ideas of A. E. Winchester, general superintendent of the South Norwalk Electric Works, and D. M. Diggs, of the General Electric Company, and was developed after it was found that no fixtures were available on the market that would fulfill the required conditions satisfactorily.

A standard prismatic-band refractor gave a good distribution, but an effort was made by the men named to improve its appearance and to reduce the glare when viewed from a point near the pole. A visit to the factory resulted in combining a frosted bowl with an 8-in. (20-cm.) band refractor, which gives the desired effect. A 2-in. (5-cm.) hole in the bottom of the bowl gives ventilation and permits dust and insects to fall out. Col-

lection of dust on the inside is avoided by the smooth and steep interior surfaces. For a similar reason it is difficult for dust or rainwater to collect or birds to find a resting place on the outside of the glassware or casing. A standard series socket with film cut-out is used for the lamps, the greater number of which are of 80 cp. By means of an elongated latch and removable globe holder and a pole with a lamp remover at one end the lamps can be easily changed and the glassware cleaned by any one standing on the street.

FIG. 1—NIGHT VIEW ON RESIDENCE STREET AFTER IMPROVING LIGHTING

The casing of the fixture was also specially made with the following objects in view: (1) To give a good balanced appearance in conjunction with the glassware and bracket; (2) to shape it so that birds could not alight thereon; (3) to provide a body large enough to accommodate a compensator for use with larger lamps, and (4) to facilitate access* to the lamp and globe for replacement and cleaning. No insulator is needed between the metal hood and the fitting for the pipe bracket on account of the low voltage (300 volts maximum) of the secondary circuit. (See Fig. 4 for outline of fixture.)

Since the glassware described above was put on the market an improvement has been made which adds a great deal to the appearance of the inclosing globe both in the daytime and the night-time, also bettering the distribution of the light. New dies have been developed which form the inner prismatic band and frosted bowl in one piece, and outside this a prismatic bowl is used which is continuous the full length of the glassware instead of stopping at the lower edge of the band. The smooth appearance of the fixture is thus enhanced, the frosted part of the glassware is not exposed to dust, and in the daytime the shoulder of heavy glass noticeable on the original fixture between the refractor and bowl is not seen and the fixture when lighted is of uniform brilliancy. The original glassware was fitted with ground joints at the top and bottom of the band refractor, whereas gaskets are now used to take up the greater expansion in the new arrangement. In Fig. 3 is shown the distribution curve for the fixture, when used with reflectors. It will be noted that the shape of the curve is such as to give uniform illumination on the street level with just the right amount below the lamps to avoid a dark or over-illuminated spot.

The brackets are made specially of 1½-in. (3.8-cm.) wrought-iron pipe with a cast scroll and the pole bands are made hollow. The wires from the lamps pass into the pole at a point in the bracket even with the lower pole band and are thence carried upward inside the pole to the cap, where they emerge from two outlets and are then brought down outside to tap on the proper service wires. A small amount of wire could have been saved by bringing the lamp leads through the upper pole band, but the hole which would have been necessary in the bracket pipe would have made the fixture weak at this point.

Circuits.—The city was laid out in four separate circuits and the lamps so arranged in the business district that in case one circuit became disabled the streets would not be in darkness. To do this the lamps on each side of the main streets are placed on separate circuits.

FIG. 2—NIGHT VIEW ON BUSINESS STREET AFTER REHABILITATING LIGHTING

It was also considered desirable to keep the high-tension lighting circuits away from the ornamental zone, which was done by placing General Electric type street-lighting transformers on side streets. These transformers are rated at 2 kva., 6.6/6.6 amp., and were inserted to reduce the potential of each secondary circuit to less than 300 volts. The lamps are fed in groups, thirteen pairs being connected on each transformer. Although the secondary circuit is a low-voltage one, the wire used in-

*Glassware holder can be opened by stick from ground.

side the poles has an insulation thickness suitable for 2500 volts working pressure to avoid insulation breakdown where the leads pass around the sharp bends. Lighting in the outlying and less important sections was

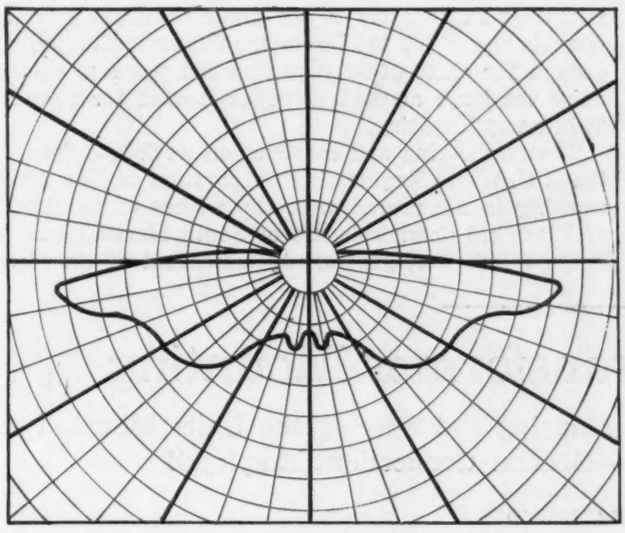


FIG. 3—DISTRIBUTION CURVE OF LIGHTING FIXTURE EMPLOYED IN SOUTH NORWALK INSTALLATION

improved by installing new brackets and band refractors. Most of these lamps were cut in directly on the secondary circuits of the constant-current transformers and were properly safeguarded. The total number of lamps are distributed as follows among the four circuits:

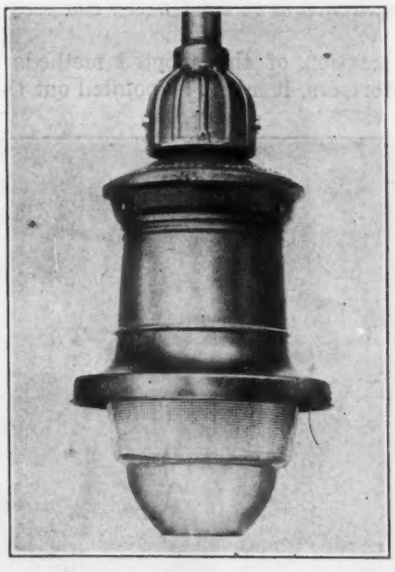


FIG. 4—FIXTURE USED AT SOUTH NORWALK

Circuit No.	80-Cp.	250-Cp.	No. of S. L. Transformers	Lamp Kw.
1	67	0	3	4.02
2	45	0	2	2.70
3	108	0	5	6.48
4	117	1	5	7.18
—	—	—	—	—
4	337	1	15	20.38*

*Of this total 286 lamps compose the ornamental lighting system.

Lamp Locations.—In the main business district the steel poles are spaced approximately 100 ft. (30 m.) apart on both sides of the street and placed opposite each other in order to carry the span wires for trolley lines where these exist. Double fixtures were placed on all the poles in the business district and on half the poles (usually staggered in position) in the residential section. The heavy foliage required many small units closely spaced to give good illumination.

As most of the residences were some distance back from the sidewalk line, it was considered advisable to have the new illumination extend back so as to light the residences. To fulfill this requirement the double fixture was especially effective, besides giving a balanced appearance to the ornamental pole during the daytime.

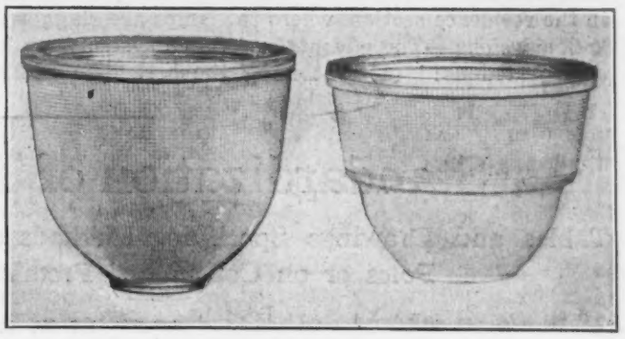


FIG. 5—IMPROVED STREET-LIGHTING FIXTURE GLASSWARE AND TYPE INSTALLED AT SOUTH NORWALK BEFORE DEVELOPMENT

The light that was reflected from the houses was not too intense to lessen the effect and added greatly to the attractiveness of the street at night. In the business

FIG. 6—DAYLIGHT VIEW OF INSTALLATION ON RESIDENCE STREET

The portion of the pole extending about 18 in. above and below the center of the filament is painted white to improve the appearance at night, as it was found that with a dark pole the sources of light did not appear to have a visible means of support. The appearance in the daytime is also improved.

district, where the stores are close to the sidewalks, it is desirable to have intense light on the building fronts.

The general effect of the illumination is very pleasing, as the light is well distributed over the surface of the street and there is no glare at any point. The lamps are placed at a height of 15 ft. (4.6 m.) above the road surface, and it has been noted by motorists and others that the intensity and distribution are so good that

lamps on the machines are not required to avoid accidents. This is one great test of the utility of any illumination.

The illumination obtained from two 80-cp. lamps on each pole was found to be quite satisfactory, but in some cases 100 cp. was used to give extra light where needed. The installation is very economical as to power requirements, two 80-cp. lamps, rated at about 60 watts each or 120 watts per pole, being installed on poles averaging 100 ft. (30 m.) apart. This makes only 240 watts per 100 ft. (720 watts per 100 m.) of streets in the business section, and 120 watts per 100 ft. (360 watts per 100 m.) in the residence section, where the lamps are staggered.

Conclusions.—The advantages of this system may be enumerated as: (1) Obtaining the best illumination possible with available design of fixtures at an initial and operating cost much less than is usual with ornamental systems; (2) the system is ornamental both day and night; (3) safety from the wireman's and passer-by's standpoint—no part of the electrical circuits is within 14 ft. (4.2 m.) of the ground and the climbing space is clear; (4) the intensity of illumination is high enough for cities of average size and yet does not require the large amount of power needed for so-called "white-way" lighting.

The engineering and construction work was done by the J. G. White Engineering Corporation of New York, working in accordance with the wishes of the Board of Electrical Commissioners of South Norwalk and of A. E. Winchester, general superintendent of the plant.

Standardization of Transformer Mounting

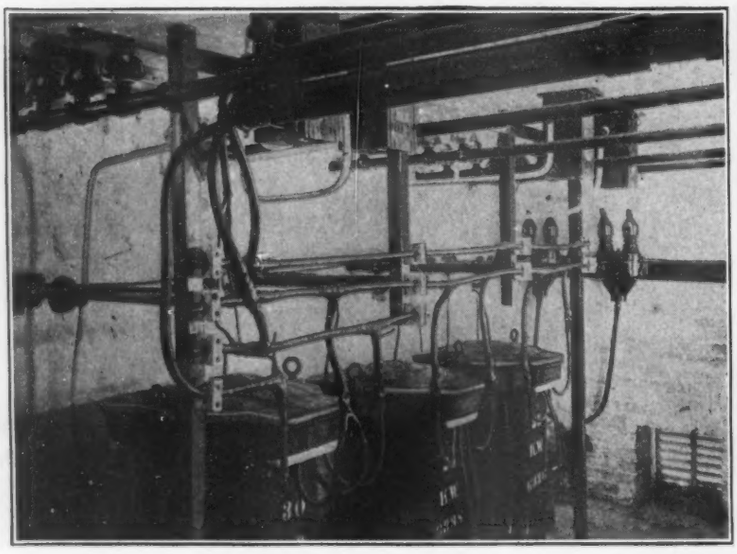
Tables and Drawings Specifying Methods of Hanging and Spacing the Units Mounted on Poles or on Consumers' Premises—General Connections Employed

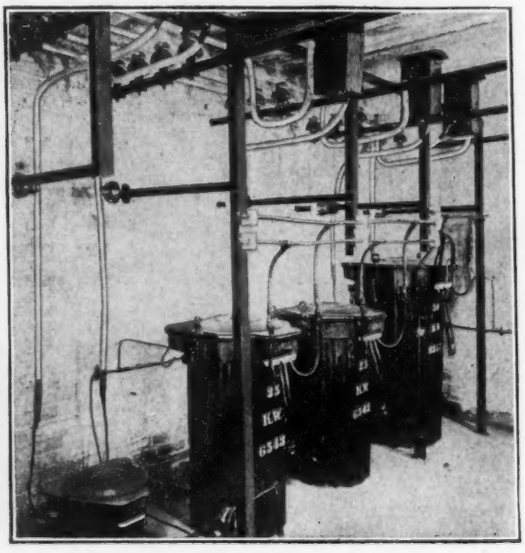
BY W. C. BLACKWOOD
Electrical Engineer New York & Queens Electric Light & Power Company

STANDARDIZATION, when it is not carried to the degree which prevents development, has usually been entirely beneficial. No exception exists in the borough of Queens, New York City, where the New York & Queens Electric Light & Power Company requires the following of specifications when transformers are installed on poles or on consumers' premises. No attempt has been made to provide detailed specifications for connections, as a diagram is made for each job, but the standard specifications show the method of hanging and spacing the transformers and the general method of making connections. The size of transformers hung on poles is limited by municipal regulations to 30 kva. for single transformers and 25 kva. for two or three transformers, and all larger transformers are placed in transformer rooms. Transformer-room installations are divided into two classes—(1) where the service is metered on the primary side, in which case a main oil-switch is installed, and (2) where the service is metered on the secondary side and the transformers are protected by fuses.

The practice, while it is not new, results in conservation of the engineering department's time, reduction of construction labor, speeding up of erection, and fewer stock parts, as well as other advantages, so the requirements of the Queens company will be outlined.

In explanation of the adopted methods of hanging the transformers, it might be pointed out that the present specifications have been in existence more than a year, or since the distribution system was changed from two-phase four-wire to three-phase four-wire.





FIGS. 1 AND 2—TRANSFORMER-ROOM INSTALLATIONS ON CONSUMERS' PREMISES

The location for hanging transformers of various sizes and groupings and the type of cross-arm to be used are specified on page 580. In selecting the gain in which to hang the transformers attention was given

to difficulties which might be encountered in hoisting, to the stresses in the pole, to the accessibility of the cut-outs and to appearance. It will be noted that only single transformers up to and including 10 kva. are permitted on the top cross-arm and that transformers over 5 kva. are permitted on the top cross-arm only when that arm is not more than 40 ft. (12 m.) above ground.

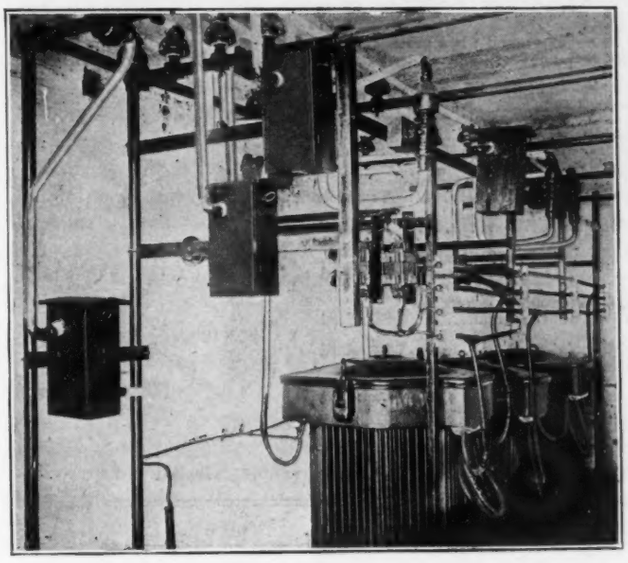


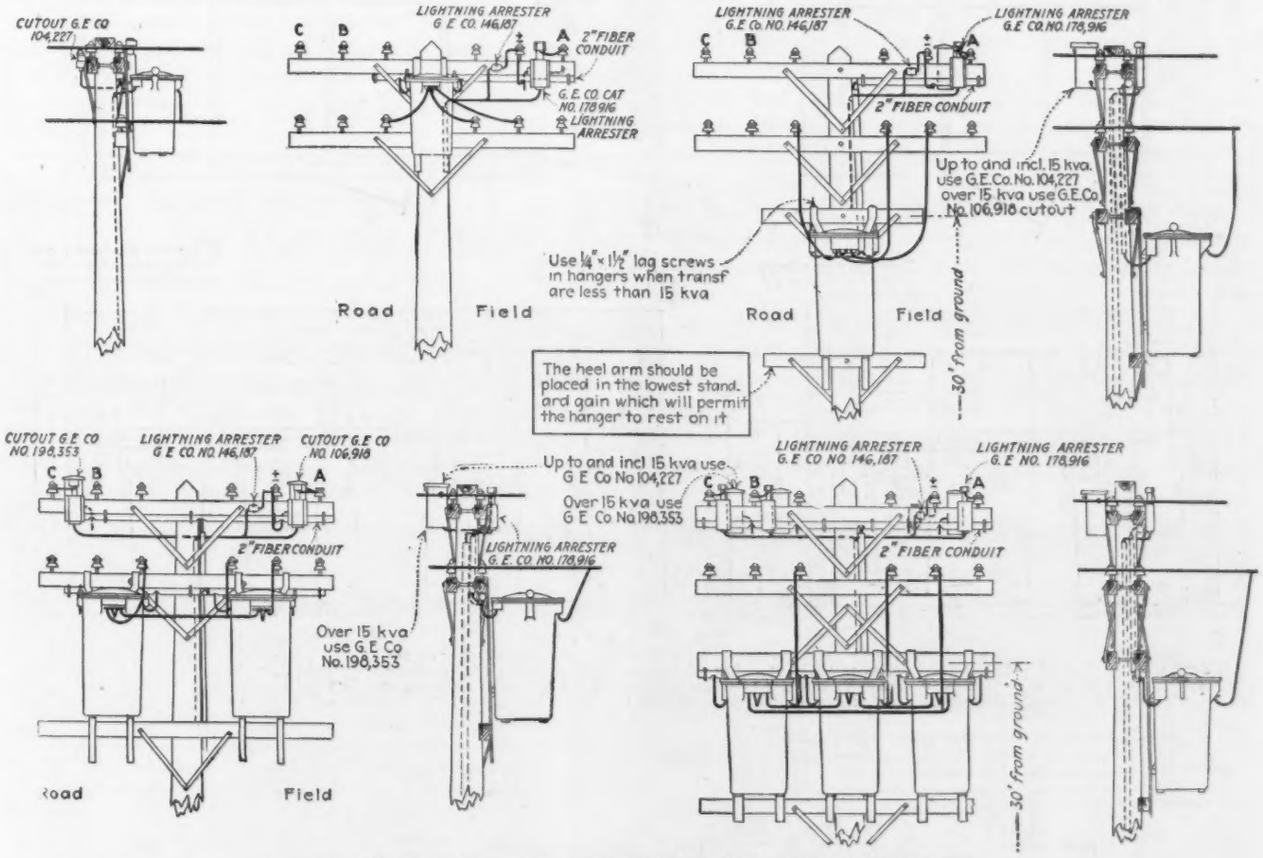
FIG. 3—ANOTHER TRANSFORMER-ROOM INSTALLATION

The limit of 10 kva. on the top cross-arm is made because of difficulty in hoisting larger transformers, and the limit of 5 kva. at a height greater than 40 ft. above ground is made to reduce the stresses in the pole. Groups of two or three transformers are hung either on the secondary cross-arm or on a transformer cross-arm 30 ft. (9 m.) above ground. They are not hung on the primary cross-arm because in such a location they would interfere with secondary wires on the arm below.

Standard cross-arms with a 3½-in. by 4½-in. (8.8-cm. by 11.3-cm.) section are used in all installations except those where three transformers of 15 kva. to 25 kva. capacity are hung, when a special arm 3½ in. by 6 in. by 8 ft. (8.8 cm. by 15 cm. by 2.4 m.) is used.

Lightning arresters are placed on the primary cross-arm on the same side of the pole, and the transformers and the cut-outs are placed on the opposite side, in which location they are more accessible for renewals. No cut-out is used in the neutral connection except in installations of three transformers, when a cut-out without plug is used to allow the connection of the neutral wire and the operation of two transformers as an open-delta bank in the event of the failure of one phase or the burning out of one transformer.

Primary connections are made with No. 8 B. & S. wire made up of thirty-seven strands, insulated with $\frac{4}{32}$ in. (3 mm.) of 30 per cent Para rubber and covered with two weatherproof braids. This wire is run, wherever possible, in 2-in. (5-cm.) fiber conduit strapped under the cross-arms and to the pole. The wire enters

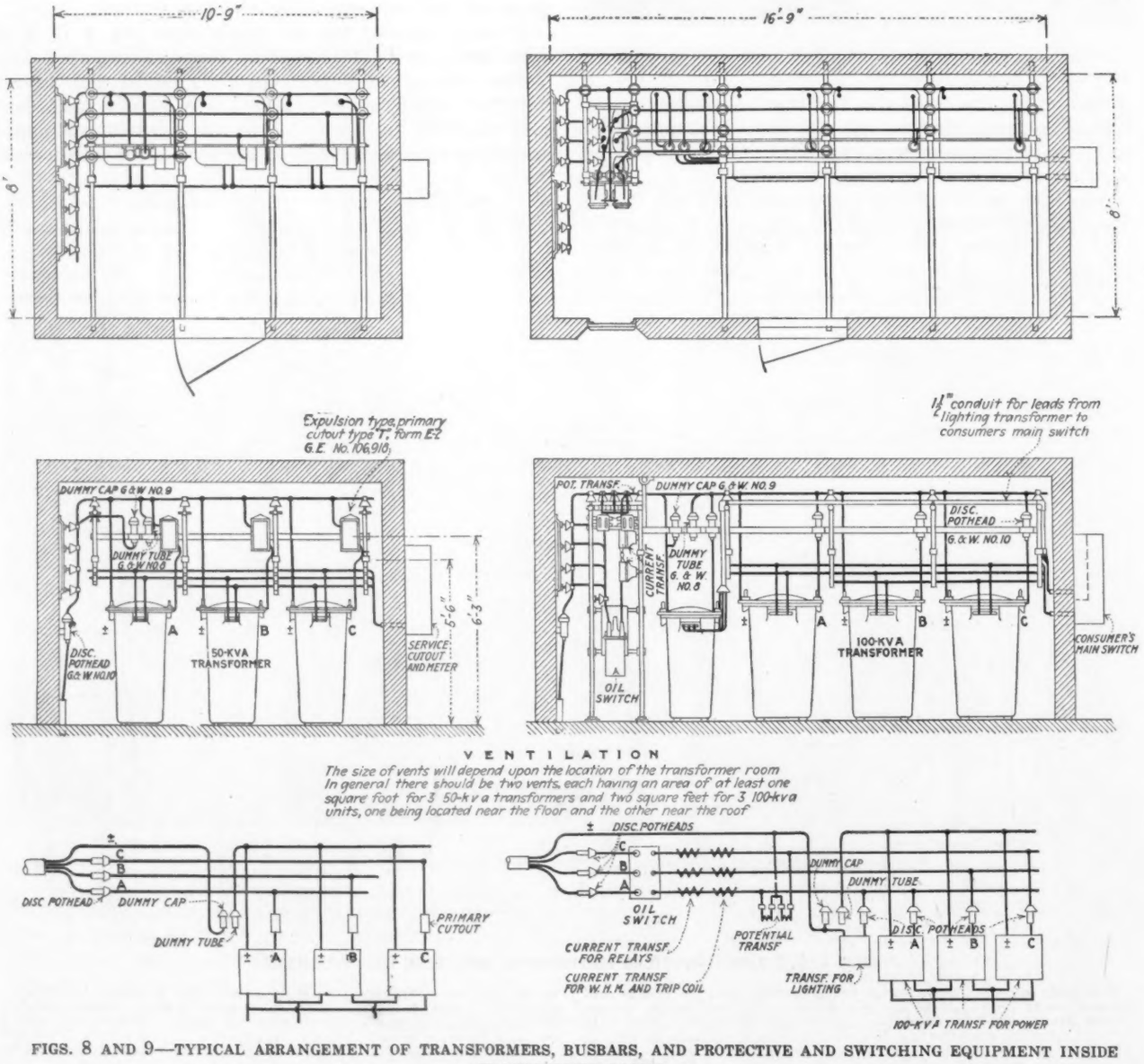

CUTOUT G.E CO 104,227
LIGHTNING ARRESTER G E CO. 146,187
2" FIBER CONDUIT
G. E. CO. CAT NO. 178,916 LIGHTNING ARRESTER
Road
Field
LIGHTNING ARRESTER G.E Co. NO. 146,187
LIGHTNING ARRESTER G.E CO. NO. 178,916
2" FIBER CONDUIT
Up to and incl. 15 kva. use G.E. Co. No. 104,227 over 15 kva use G.E. Co. No. 106,918 cutout
Use ¼" × 1½" lag screws in hangers when transf are less than 15 kva
The heel arm should be placed in the lowest stand. and gain which will permit the hanger to rest on it
30' from ground
CUTOUT G.E CO NO. 198,353
LIGHTNING ARRESTER G E CO. NO. 146,187
CUTOUT G.E CO NO. 106,918
2" FIBER CONDUIT
Over 15 kva use G E Co No. 198,353
Up to and incl 15 kva use G E Co No 104,227
Over 15 kva use G E Co No 198,353
LIGHTNING ARRESTER G. E. CO. NO. 178,916
LIGHTNING ARRESTER G E CO NO. 146,187
LIGHTNING ARRESTER G. E NO. 178,916
2" FIBER CONDUIT
30' from ground

FIGS. 4, 5, 6 AND 7—TYPICAL METHODS OF MOUNTING TRANSFORMERS

The table on the following page indicates whether the transformers must be mounted on the primary, secondary or transformer cross-arm and also the size of arm required. Fig. 4 is the arrangement used for single transformers of ratings up to and including 10 kva. when mounted on the primary arm. Fig. 5 indicates the mounting of a single transformer rated at 7.5 kva. to 30 kva. on a transformer cross-arm. Fig. 6 shows two transformers mounted on the secondary arm and is typical of the arrangement for the same number of units. When the rating exceeds 25 kva. they cannot be mounted on poles. Fig. 7 is the arrangement employed for three transformers rated at 7.5 kva. to 25 kva. when mounted on a transformer arm as shown.

LOCATION FOR TRANSFORMER AND SIZE OF CROSS-ARM

Number of Transformers	Size	Hang Transformer On	Type of Cross-Arm
Single transformer	Up to and including 5 kva	Primary arm, any height pole	Standard
Single transformer	7.5 to 10 kva., inclusive	Primary arm, when not more than 40 ft. above ground	Standard
		Transformer arm, 30 ft. above ground when primary arm is more than 40 ft. above ground	Transformer arm 3½ in. by 4½ in. by 4 ft. 6 in. long
Single transformer	1.5 to 30 kva., inclusive	Primary arm, when not the top arm and when not more than 40 ft. above ground	Standard
		Secondary arm, when not more than 40 ft. above ground and when primary arm is the top arm	Standard
		Transformer arm, 30 ft. above ground when secondary arm is more than 40 ft. above ground	Transformer arm 3½ in. by 4½ in. by 4 ft. 6 in. long
Two transformeers	Up to and including 5 kva	Secondary arm, any height pole	Standard
Two transformers	7.5 to 25 kva., inclusive	Secondary arm, when not more than 40 ft. above ground	Standard
		Transformer arm, 30 ft. above ground when secondary arm is more than 40 ft. above ground	Standard
Three transformers	Up to and including 5 kva	Secondary arm, any height pole	Standard
Three transformers	7.5 to 10 kva., inclusive	Secondary arm, when not more than 40 ft. above ground	Standard
		Transformer arm, 30 ft. above ground when secondary arm is more than 40 ft. above ground	Standard
Three transformers	15 to 25 kva,. inclusive	Transformer arm, 30 ft. above ground	Transformer arm, 3½ in. by 6 in. by 8 ft. long


10'-9"
16'-9"
8'
Expulsion type primary cutout type T, form E-2 G.E. No. 106,916
1½" conduit for leads from lighting transformer to consumers main switch
DUMMY CAP G.&W. NO. 9
DUMMY TUBE G.&W. NO. 8
DISC. POTHEAD G.&W. NO. 10
50-KVA TRANSFORMER
SERVICE CUTOUT AND METER
5'-6"
6'-3"
POT. TRANSF.
CURRENT TRANSF.
OIL SWITCH
100-KVA TRANSFORMER
CONSUMER'S MAIN SWITCH
VENTILATION
The size of vents will depend upon the location of the transformer room In general there should be two vents, each having an area of at least one square foot for 3 50-kv a transformers and two square feet for 3 100-kva units, one being located near the floor and the other near the roof
DISC. POTHEADS
DISC POTHEAD
DUMMY CAP
DUMMY TUBE
PRIMARY CUTOUT
CURRENT TRANSF FOR RELAYS
CURRENT TRANSF FOR W.H.M. AND TRIP COIL
POTENTIAL TRANSF
TRANSF. FOR LIGHTING
100-KVA TRANSF FOR POWER

FIGS. 8 AND 9—TYPICAL ARRANGEMENT OF TRANSFORMERS, BUSBARS, AND PROTECTIVE AND SWITCHING EQUIPMENT INSIDE TRANSFORMER ROOMS

and leaves the conduit through notches sawed in the under side. No attempt is made to make a fitted joint where the horizontal runs meet the vertical conduit and the ends of the conduit are left open. In all cases the neutral wire is connected to the left-hand terminal of the transformers and the transformers are arranged and connected in the same order as the primary wires on the cross-arm. The detailed methods of hanging transformers and the general method of making connections are shown in the accompanying drawings.

Where transformers are installed on consumers' premises the consumer is required to furnish a fireproof room properly ventilated to the outside air. The size of typical rooms and the arrangement of apparatus are shown in the accompanying drawings. The smallest room specified will accommodate three 50-kva. transformers and the largest will accommodate three 100-kva. power transformers and a smaller transformer for lighting. Consumers having a greater load than 300 kva. are usually supplied at 6600 volts.

Primary service is brought into the transformer rooms underground, single-conductor cables being used. The cables terminate in disconnecting potheads, and from the potheads a primary bus is carried over the transformers on a pipe framework. When an oil switch is installed the control for the switch, the relays, meters, etc., are installed on a panel immediately outside the transformer room. In such installations no fuses are used on the power transformers but potheads are installed for use as disconnectives.

The secondary wiring is run on cleats in a vertical plane in front of and above the transformers.

The drawings for both the pole and transformer-room installations are reduced to letter size, and copies, together with a set of general specifications, are supplied to each foreman so that all work is carried out according to the standard plan and in an economical way.

SHORT COURSE PROVIDED FOR ELECTRIC METERMEN

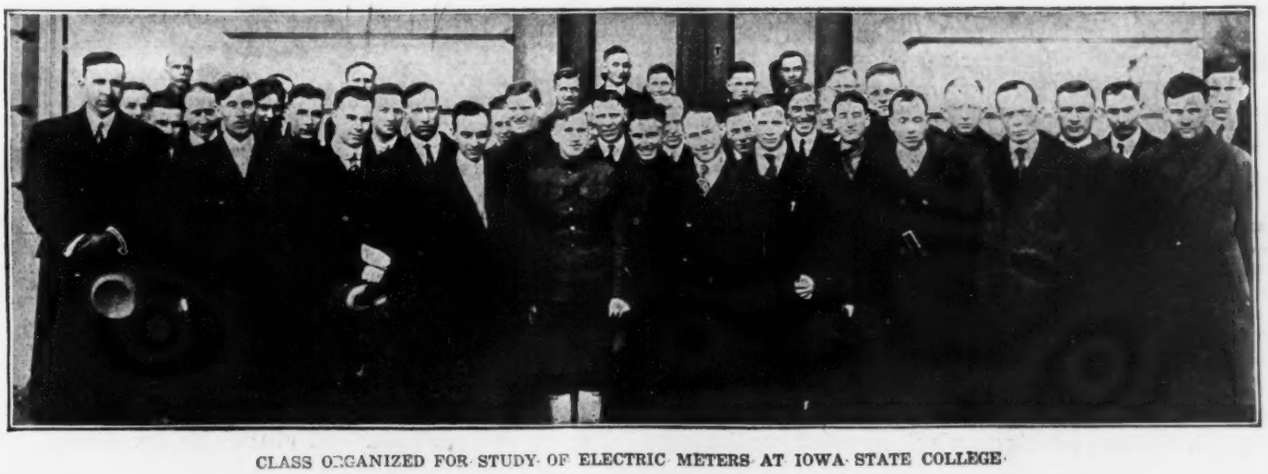
Iowa State College Does Practical Work for Electric Service Companies in the State by Assisting in Education of Employees

To comply with the requests of a number of the electric companies of the state, the engineering extension department of the Iowa State College, Ames, offered a four days' course, Feb. 18 to 21 inclusive, for electric metermen. This course was the first one of its kind offered in Iowa, if not in the United States. It proved of special interest to employees of those companies which do not find it possible to provide training for meter testers. There were, however, many plant owners among those registered. Thirty-five men, representing nearly as many different companies, attended the meetings. The engineering extension department had direct charge of the course. Prof. F. D. Paine of the electrical engineering department had charge of the instruction work. He was assisted by Prof. A. B. Campbell, of the engineering extension department, and C. C. Crawford, formerly of the meter department of the Upper Iowa Power Company.

The instructional work consisted of lectures, discussions, demonstrations and laboratory work. The lectures and discussions were based on a list of questions which applied to the construction, operation, testing and repair of the important makes of meters. The laboratory work followed this same plan, and the men were able to put into practice the important points which they were studying. Rotating standards were used.

In connection with the short course the different manufacturers placed on exhibit the latest types of meters and loading devices. Specialists from these companies gave very interesting talks on the development, construction, testing and manufacturing of the induction type of meter. The electrical engineering department had a historical exhibit showing the many stages of development from the lamp-hour meters to the present types. Special emphasis was placed on the benefits of accurate registration, the results obtained through good service, and the relation of the meterman to the consumer. Those in attendance have asked for a more advanced course for another year.

At the last session held by the metermen those in attendance formed the Iowa Electrical Metermen's Association. Prof. F. D. Paine, of the electrical engineering department of Iowa State College, was elected the first president. George T. Gibson, of the Gibson Electric Company, Des Moines, Iowa, was elected to the combined offices of vice-president and secretary-treasurer. The primary purpose of the organization is to place before its members the important features relative to the operating, testing and repairing of meters and to form a closer relationship with the business and operating part of the central-station business. At least annual, if not semi-annual, conventions will be held. Committees are being appointed to complete the organization.



CLASS ORGANIZED FOR STUDY OF ELECTRIC METERS AT IOWA STATE COLLEGE

ELECTRIC GENERATION AND DISTRIBUTION IN CANADA

Leo G. Denis, of Canadian Commission of Conservation, Shows High Standard of the Country in Electric Development—Utilization of Water Power

"IT IS sometimes stated that the degree of progress and civilization of a country may be gaged by its electric development; in this respect, and with due regard to population, the results of the investigation shown in this report demonstrate quite clearly that Canada stands in the front rank." This is the introduction to a report by Leo G. Denis, hydroelectric engineer of the Commission of Conservation of Canada, on "Electric Generation and Distribution in Canada." Following are extracts from the report:

"The information shows that there are a total of 565 electric generating plants in Canada, with an aggregate capacity of 2,107,743 hp. and supplying not less than 752 distributing systems of varying importance, which cover some 973 places. There are 270 hydroelectric plants aggregating 1,806,618 hp., 201 steam plants aggregating 288,202 hp., 49 gas plants aggregating 8157 hp. and 45 oil or gasoline engine plants aggregating 4766 hp., making the total of 2,107,743 hp.

"Usually the large hydroelectric installations are of most substantial construction, and the most expert engineering advice has been obtained, while the equipment is in keeping and comprises both hydraulic and electrical machinery of the most efficient type. The same, unfortunately, cannot be said of many of our small plants, and, particularly in the older ones, there is undoubtedly great room for improvement.

"The same comment applies to our steam plants; the large ones, although a number of them are only used as auxiliaries, are very efficiently equipped and operated, but many of our small plants show much room for improvement. There are many small plants in the prairie sections, where the price of fuel is high, the majority of them using oil, gasoline or producer gas. Considering such municipalities and others in their vicinity which desire electric service, it would seem to be worth while to generate energy in large steam plants, situated at suitable distribution centers, and thus supply transmission systems extending to the various communities within economic radius.

RATIO OF MUNICIPAL AND PRIVATELY OWNED PLANTS

"The ownership of the various plants is divided into 207 municipal or publicly owned plants of 452,508 hp. total rating and 358 privately owned plants of 1,655,235 hp. total rating.

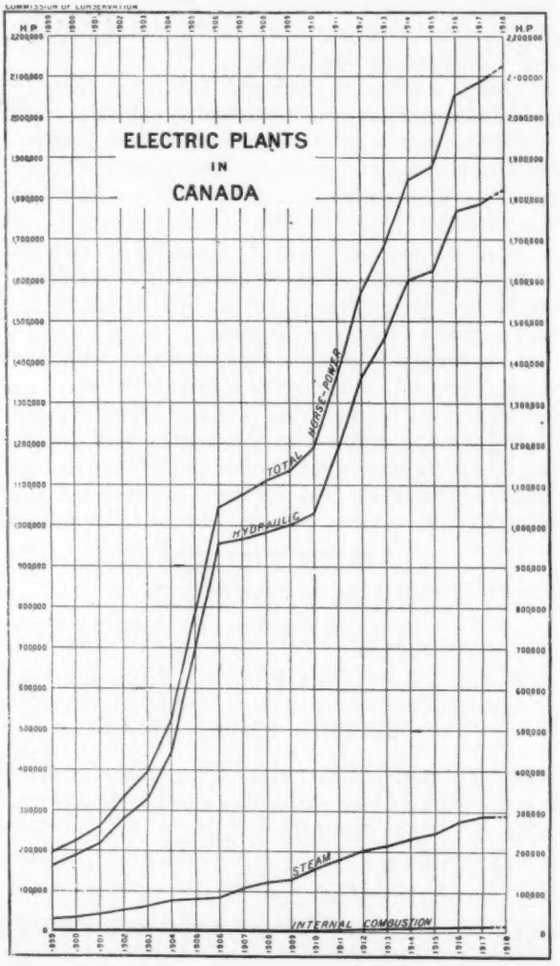
"Our largest hydroelectric development is 488,800 hp. in the three larger power plants at Niagara. The large installations are not all confined to this site, however, there being five plants of over 100,000 hp. and thirty-six plants of over 10,000 hp. rating. The average head of water utilized is not exceedingly high, but many of our large hydroelectric plants operate under fairly high heads, such as 140 ft. to 180 ft. (42 m. to 54 m.) at Niagara, 145 ft. (44 m.) at Shawinigan, 83 ft. (25 m.) at Grand'mere and 400 ft. (122 m.) at the Coquitlam-Buntzen plants near Vancouver.

"The plant at Hamilton, Ont., 26,667 hp., is the largest steam-power plant in Canada and is used as an auxiliary, while the plant at Edmonton, Alta., 14,234 hp., is the largest steam plant operated continuously.

"The cost of generation for hydroelectric plants is usually given in dollars per horsepower-year, and among the lowest reported is a cost of $8.50 per horsepower-year, the plant being only of about 10,000 hp. rating, but operating under a 90-ft. (27-m.) head. For very large plants the cost should be even substantially lower, while for plants of the same order it varies from $8.50 to $15 per horsepower-year; in smaller hydroelectric plants $30 to $40 per horsepower-year may be reached.

"Lines of various voltages from 10,000 upward aggregate 5490 miles (8835 km.) and are as follows: 10,000 to 30,000 volts aggregate 2428 miles (3907 km.); 30,000 to 99,000 volts aggregate 2485 miles (4010 km.); 100,000 volts and upward aggregate 577 miles (925 km.).

"The cost per mile of the different lines naturally varies with the mode of construction, size and number



GREAT GROWTH OF OUTPUT OF ELECTRICAL ENERGY SHOWS HIGH STANDARD OF DEVELOPMENT IN CANADA

of conductors and voltage for which constructed. For voltages of from 10,000 to 50,000 the figures given show a wide variation of from $600 to $11,000 per mile, while on 100,000-volt lines and more we have from $7,500 to $14,000 per mile.

"Of the 752 distribution systems in Canada, 389 are municipally or publicly controlled, while 363 are under private ownership. The systems included cover a total of 11,852 miles of streets and supply 730,697 consumers with an estimated connected load of 497,846 kw. for lighting and appliances and 970,505 hp. for power."

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

OUTDOOR TRANSFORMERS

Made Standard for Self-Cooled Units with Certain Exceptions to Meet Demand

During the past two or three years the demand for outdoor-type construction has been extended to cover self-cooled units in power sizes quite generally. Water-cooled transformers are not so much affected, and in no case has this tendency extended to air-blast transformers. In view of this tendency the Electric Power Club, which is representative of transformer manufacturers, has approved the standardization of outdoor construction for self-cooled distribution and power transformers under the following conditions:

Single-Phase.—When ratings are the same as those listed in the Electric Power Club's rules as standard for light and power service or where the voltage rating is above the limits of the 33,000-volt class and where the low-voltage rating is identical with or higher than the standard low-voltage rating listed in the rules mentioned.

Three-Phase.—Where ratings are equivalent to the single-phase ratings mentioned. This rule is intended specifically to exclude transformers for special service such as those for operating synchronous converters, electric furnaces, etc., where the low-voltage currents are very heavy, making the outdoor construction difficult and expensive to obtain and where the outdoor construction is not usually required because of the practice generally to install such transformers indoors.

PECULIAR CASE OF TROUBLE WITH POLYPHASE MOTORS

They Kept Three-Phase Supply Line Energized So Other Motors Could Be Started Even When Normal Polyphase Supply Was Cut Off

BY L. E. BROWN
Superintendent Distribution Springfield Light, Heat & Power Co.

A peculiar case of trouble recently was called to the attention of the service department of the Springfield (Ohio) Light, Heat & Power Company by one of its larger factory customers. This factory is supplied with 220-volt, three-phase alternating current from a bank of transformers. Practically all of the machinery in a new building is operated from line shafting driven by a 50-hp. motor supplied through a No. 3/0 line in conduit. A number of other motors in other parts of the factory operate from the same supply line. The transformers are protected against overload by main-line secondary fuses, and each motor has a set of fuses, switch and compensator.

About 5 o'clock the factory called up the company and complained of low voltage, stating that the big motor and its line had been running very hot for an hour or more, and that in fact the conduit was smoking. The factory closes soon after 5, and by the time the trouble man reached the location all but one of the other motors were shut down. A test lamp showed voltage on all three phases, both ahead of and behind the 50-hp. motor fuse, although it was noticed in a casual way that the light burned brightly only on two phases. No importance was attached to this at the time. However, the motor would not start the line shafting, although it would attempt to do so. The compensator was held to the starting position for some time in an attempt to start the motor by idling the belt, and during this period the factory electrician noted that the other motor, which was already running, stopped. Following this, the 50-hp. motor would not attempt to start. The main-line fuses were at once examined, and one of them was found blown.

An analysis of the situation led to the following conclusion: During the time when the heating occurred and up to the hour of closing all motors had been operating from a single-phase supply following the blowing of one of the main secondary fuses. During this time the 50-hp. motor was started and stopped a number of times, and the other motors had of necessity supplied polyphase power for so doing, they being themselves driven and excited from the single-phase supply. The prolonged attempt to start with only one motor running proved too much for it, and it died down, depriving the 50-hp. motor of anything but single-phase power.

THE ESTIMATED COST OF OVERHEAD INTERCONNECTION

Data Refer to Lines Linking the Edison Illuminating Company of Boston and the New England Power Company

The proposed tie line between the system of the Edison Electric Illuminating Company of Boston and the New England Power Company, to which reference has been made in the ELECTRICAL WORLD, will begin at the "L" Street station in South Boston and extend underground to Forest Hills, thence by overhead route, chiefly along the right-of-way of the New York, New Haven & Hartford Railroad, to Baker Street, with a connection to the Dedham substation of the Edison company. At Baker Street it is proposed to install transformers to raise the pressure from 25,000 volts to 66,000 volts for transmission to the Metropolitan Water Board's plant at the Sudbury dam, in Southboro. At the latter point connection will be made with another 66,000-volt line built by the Metropolitan board and tying the Edison line, Sudbury and Wachusett plants into the New England Power Company's system at Clinton.

The estimated cost of the overhead-line construction as recently prepared totals $302,084. The details of this estimate are shown in the accompanying table. It may

be seen that for the 66,000-volt section the estimated cost is about $10,000 per mile. Steps are now being taken to secure locations for early construction.

FOREST HILLS—DEDHAM SECTION

Length	5.9 miles
Line pressure	25,000 volts
Type of line	Wooden pole
Number of pole lines	1
Number of circuits per pole (three-phase)	2
Range in pole lengths	35 ft. to 65 ft
Type of insulators	Pin
Type of cross-arms	Steel
Average pole spacing	120 ft.
Size of conductors	Equivalent to No. 3/0
Estimated cost (two circuits):	
Superintendence, timekeeping, surveys, etc.	$3,507
Poles erected	17,012
Clearing	3,430
Cross-arms, insulators, etc.	18,735
Conductors erected	56,500
Right-of-way rental, basis $400 per mile per year	.....
Total section	$100,084

BAKER STREET—SOUTHBORO SECTION

Length	20 miles
Line pressure	66,000 volts
Type of line	Wooden poles
Number of pole lines	1
Number of circuits per pole (three-phase)	1
Type of cross-arm	Wishbone steel
Type of insulators	Suspension
Location of line, chiefly on private right-of-way:	
Maximum width of right-of-way	125 ft.
Average pole and spacing	225 ft.
Size of conductors	No. 3/0
Estimated cost (one pole line):	
Superintendence, timekeeping, surveys, etc.	$7,450
Poles erected	27,400
Clearing	13,040
Cross-arms, insulators, etc.	39,550
Conductors, erected	47,360
Camp operation	3,200
Right-of-way	64,000
Total section	$202,000

THE REPAIR OF DAMAGED COILS IN TRANSFORMERS

Method Which Does Not Require Rewinding and Is Permanent Enough for Continued Operation Is Recommended

BY G. A. ILER

Superintendent Operation, Tests and Repairs, Georgia Railway & Power Company

Quite often lightning and other electrical disturbances enter a transformer and only damage one spot in a coil. Sometimes only one wire is burned in two, other times a dozen, leaving a hole the size of a dinner plate. In this case the usual practice is to order a new coil from the factory or make one in the shop.

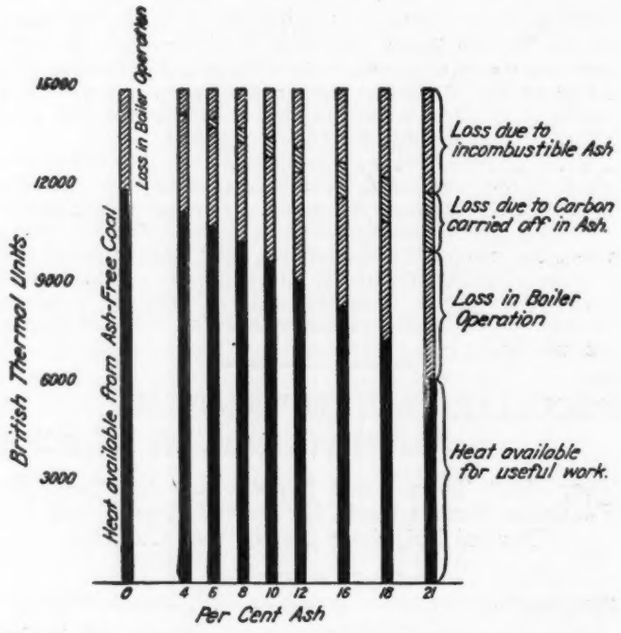
The writer has adopted a new method, which is to separate all the burned ends and clean them carefully, tagging the ends that belong to each other. After the charred insulation is removed from adjacent wires and surfaces, the ends are prepared for welding by beveling them a little, and a new piece of copper of proper length and cross-section is welded in this open gap between each set of ends, care being taken not to get any of the flux on other parts of the coil.

These wires are then carefully reinsulated with silk ribbon used as tape and some baking varnish. The reason silk is used is because it has a closer weave and is thinner than anything else, which allows more plies to be put on a wire before the wires become so large they will crowd each other out of place. Where large copper ribbon is burned open several strands of the equivalent cross-section have been used. Precaution must be taken, however, to transpose the strands if they are long enough to make several turns of the coil of which they are a part. This is necessary to make each wire the same length as the others with which it is in parallel and thus carry equal current.

FUEL HEATING VALUE REDUCED BY PRESENCE OF ASH IN COAL

As Percentage of Ash Increases Percentage of Combustible Lost with Ash Also Increases, Thus Still Further Reducing Boiler Efficiency

The heating value per pound of combustible (*i.e.*, ash and moisture-free coal) of all coals approximates 15,000 B.t.u. (1710 cal. per kg.). There are some variations from this figure, but as a general average it is about correct. The variation in the heating value of coal is consequently largely due to the varying percentage of the ash, the effect of moisture being less important except in a few cases of unusual moisture content. If an



REDUCTION OF HEAT VALUES DUE TO PRESENCE OF ASH IN COAL

ash-free coal could be obtained a heating value of about 15,000 B.t.u. per pound would be expected.

The percentage of ash has a distinct influence on the boiler efficiency. As the quantity of ash increases in percentage it becomes more difficult for the fireman to burn combustible completely. With a low percentage of ash and good firing it is expected that the ash removed from the boiler will contain approximately 25 per cent of its own weight of unconsumed combustible. As the percentage of ash increases the percentage of combustible lost in the ash also increases very rapidly. With coal containing a high ash percentage it is rarely possible to reduce the percentage of combustible in the ash to under 50 per cent of the weight of the ash.

This information was taken from a report of the engineering committee of the National Research Council to the National Coal Association as prepared by the J. G. White Engineering Corporation of New York City.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

INTEREST IS GROWING IN FARM-LINE EXTENSIONS

Farmers, Besides Being More Prosperous than Formerly, Are Learning the High Comparative Cost of Isolated Plants

One electric lighting company in the Middle West reports a very active inquiry in the matter of farm-line extensions to serve the farmers in the vicinity, and other companies are no doubt experiencing a very considerable amount of interest along this line. This, it is stated, is brought about principally by two causes: First, the farmer is more prosperous than he has ever been and has the ready means for providing himself with modern necessities, and electricity is in this class; second, the existing high cost of isolated installations has caused him to give consideration to the question of extensions for his service.

DETAILS OF CONNECTED LOAD IN SOUTHERN CALIFORNIA

Although 3030 Customers Were Added in 1918, Restrictions and Daylight Saving Kept Down Increase in Energy for Lighting

Some interesting figures on the details of connected load in horsepower of the Southern California Edison Company and subsidiary companies are given below:

	1918	1917
Lighting	219,111	210,078
Pumping plants for irrigation	104,786	93,218
Cement manufacturing and rock crushing	22,721	25,076
Railway	102,132	89,838
Municipalities, for resale	4,367	3,667
Municipalities, pumping, sewers, etc.	7,714	6,831
Ice making and refrigeration	4,379	3,501
Motion-picture industry	2,935	2,328
Industrial heating	2,036	1,741
Electric cooking	18,867	13,918
Industrial and miscellaneous	113,884	100,730
Total	602,932	550,926

The daylight-saving law and orders issued by the Fuel Administration limiting the use of electric energy for street, sign and window lighting had a marked effect on the amount of energy used during the year for lighting purposes. Notwithstanding that there were added to the company's lines during the year 3030 lighting consumers, the total number of kilowatt-hours distributed for lighting purposes increased only 2.29 per cent over the previous year, but, owing to the fact that the company's schedules for lighting service provide that with a decreased consumption the rate per kilowatt-hour automatically increases, the revenue from lighting service shows an increase over the previous year of 4.09 per cent. With the withdrawal of the restricting orders, lighting revenue from existing consumers may be expected to increase substantially.

"As after-war readjustment progresses in southern California the demand for electric energy for all practical purposes is greater than ever before," the president of the company states in his annual report. "The strenuous work of the past twelve months has further demonstrated and emphasized the utility, flexibility and economy obtained by the use of electric motive power, and many power users who formerly were wedded to other prime movers are now converted and ready for a change to electricity. A large power, heating and lighting load is now ready to be taken on in territories relatively close to existing lines."

THE ELECTRIC HEATING OF RESIDENCES A DREAM

The Costs Which Would Be Involved in Heating a Five-Room House Are Shown to Make the Project Prohibitive

At the conclusion of a paper devoted to the principles involved in heating houses electrically, presented before the Idaho Public Utilities Commission a short time ago, Joseph F. Merrill, director of the School of Mines and Engineering of the University of Utah, outlined the expense involved in a typical case of house heating by electricity.

"Let us assume a five-room or six-room bungalow cottage," said Professor Merrill, "of the design common in the smaller towns (and also in the cities) of Utah and southeastern Idaho. It would have a heating exposure of about 25 ft. by 15 ft. by 40 ft., or 15,000 cu.ft., and would require, to be comfortably heated in zero weather, an installation of 15 kw. delivered to the house. With 25 per cent line and transformer losses from the plant to the house, this would require 20 kw. capacity at the central station. At a cost of $200 per kilowatt, this would require $4,000 investment in plant capacity alone, to which line, substation and distribution capacity would add at least $100 per kilowatt of station capacity, thus giving a total investment of $6,000 for heating plant for this house. If we assume, as we have heretofore done, that this capacity could be otherwise utilized for one-half of the year, we would still have an investment of $3,000 in heating plant for the house with fixed charges at 12 per cent, amounting to $360 per year, to which operating costs must be added. To state accurately what these operating costs would be would require a careful analysis of modern station practice which I have not had an opportunity to make. The larger part of these costs are incurred beyond the plant switchboard in transmission and distribution, and they vary with the particular transmission and distribution systems. Station output costs are disclosed by operating reports of various stations.

"The thirteenth annual report of the Reclamation Service, page 35, gives the output cost of the Minidoka plant for the year 1913 (multiplying the kilowatt output by the cost per kilowatt-hour and dividing by the rated capacity) at a trifle over $5 per kilowatt. (This low cost is possible because no interest, taxes or in-

surance is charged.) The actual costs of distribution per kilowatt sold would probably be at least three times this amount.

"If we charge but half of an aggregate cost of $20 per kilowatt delivered to the heating load, the cost of delivering 15 kw. to residence heating appliances is increased by $150, giving a total cost of $510 for heating a five-room cottage. The same quantity of heat would be produced by direct heating apparatus in the house from approximately 10 tons of coal, at a cost of about $80.

"In this statement I have assumed the fixed charges to aggregate 12 per cent. This would allow 6.5 per cent interest, 3.5 per cent depreciation and 2 per cent taxes and insurance. If the state should own and operate power plants and could finance such plants with money borrowed at 4.5 per cent, it could save about 4 per cent in interest and taxes, or about $16 per year per kilowatt of capacity delivered, in fixed charges. This, however, would affect our heating load on the assumptions made above only by one-half of this amount, or $8 per year per kilowatt, or $120 per year per residence having 15 kw. demand, giving us a net heating bill for one of these residences of about $390 as against $510. So too, if it be contended that the installation costs assumed here are too high, it would make very little difference, from a practical standpoint, if the percentage of error should be as high as 50 per cent in the total installation, because that would decrease the fixed charges only by one-third, or to $240, for a 15-kw. heating plant in private ownership, or $160 under state ownership. The operating expense would still remain the same, giving a heating cost of $310 to $390. However, I am confident that my former figures are much more nearly correct for continuous-load capacity of stations as distinguished from mere rated capacity of machines, or mean flow of streams, than my latter.

"Another way of attacking the problem is to find the electric heat equivalent of one ton of bituminous coal and to find at what price electric energy would have to be sold to make electric heat the same price as heat from coal.

"Let us assume a house-heating plant to have 60 per cent efficiency, that a ton of coal costs $10 and that 1 lb. of coal has 12,000 B.t.u.'s. Then there would be delivered from one ton of coal $12,000 \times 2000 \times 0.6 = 14,400,000$ B.t.u.'s, which divided by $3412 = 4220$ kw.-hr., equivalent to a ton of coal. This would have to be sold at the electric heater for $10, or 0.23 cent per kilowatt-hour, which is impossible, commercially considered.

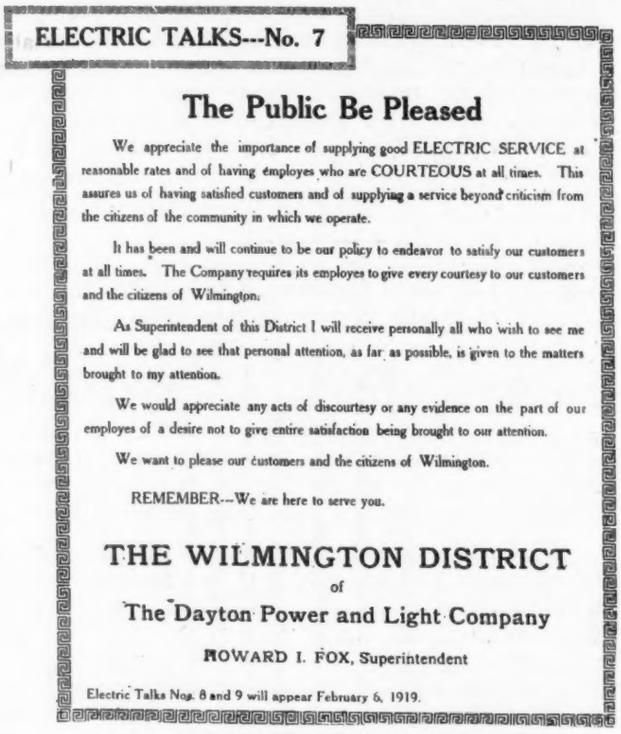
"The problem of heating on any extensive scale would be much complicated by the very sparse use of heating appliances. If it be assumed that a few well-to-do people in the town could pay from $375 to $650 a year for heating a small residence, they would be so very few that the installation required for their service would be rendered still more disproportionate in cost to the value of the service rendered by the lack of use of these facilities by their poorer neighbors, so that the heating costs must be recalculated again to a figure where even the favored few would find the heating service too costly to be practicable.

"Electric heating is, from an economic standpoint, a sort of alchemist's dream. We all know that electricity does produce heat, and we all realize and appreciate what a wonderful thing it would be to dispense with our coal piles and ash pits, our smoke, dust and cinders, and would therefore fain think it practicable. But a most cursory study of the subject, from the standpoint either of thermal dynamics or social or economic science, shows that it is utterly impossible."

INJECTING PERSONALITY INTO PUBLIC POLICY ADVERTISING

Series of Twelve Advertisements Strengthen Position of Local Superintendent with His Own Community

One of the objects of the Dayton (Ohio) Power & Light Company in running a series of twelve advertisements in the newspapers of Wilmington, Ohio, was to put the local superintendent, a new man, before the people in the right light. All of these advertisements were signed "Dayton Power & Light Company, Howard I. Fox, superintendent." Topics discussed included the character and quality of the service of the company,



ELECTRIC TALKS---No. 7

The Public Be Pleased

We appreciate the importance of supplying good ELECTRIC SERVICE at reasonable rates and of having employes who are COURTEOUS at all times. This assures us of having satisfied customers and of supplying a service beyond criticism from the citizens of the community in which we operate.

It has been and will continue to be our policy to endeavor to satisfy our customers at all times. The Company requires its employes to give every courtesy to our customers and the citizens of Wilmington.

As Superintendent of this District I will receive personally all who wish to see me and will be glad to see that personal attention, as far as possible, is given to the matters brought to my attention.

We would appreciate any acts of discourtesy or any evidence on the part of our employes of a desire not to give entire satisfaction being brought to our attention.

We want to please our customers and the citizens of Wilmington.

REMEMBER---We are here to serve you.

THE WILMINGTON DISTRICT
of
The Dayton Power and Light Company

HOWARD I. FOX, Superintendent

Electric Talks Nos. 8 and 9 will appear February 6, 1919.

TYPICAL PERSONAL-RELATIONS ADVERTISEMENT

the relation of the utility company to the prosperity of the community, rates, and the sale of stock to customers. One of the advertisements which is typical of the personal flavor injected into these announcements is reproduced. The result of the campaign was quite gratifying. The idea of square dealing and courteous treatment expressed in the advertisements has won for the company and the new superintendent a host of friends, which, in the words of the superintendent, "make the advertisements worth to the company ten times what they cost." This effect was noticed not only in the town itself but in the surrounding rural community. As to direct returns in new business resulting from the advertisements, the effort was also quite successful in this way. The net increase in meters during January and February, 1919, which was the month in which the advertisements were run, is 200 per cent more than it was in the corresponding month of 1918. The appliance sales were also better.

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Efficiency Curves of a Continuous-Current Motor.—THOMAS CARTER.—In order to determine the influence of the distribution of losses on the efficiency curves of a continuous-current motor the author divides these losses into constant losses and variable losses, assuming that the variable losses vary with the square of the current and that the constant losses change only with speed and flux density. He derives in the first article of the series equations which show the dependence of efficiency on the various losses and presents some curves showing the variation of efficiency for various values of the variable k, which is the ratio between variable losses and total losses.—London *Electrician*, Feb. 21, 1919.

Power and Torque in Electric Motors.—JUSTIN LEBOVICI.—The author presents a discussion of power and torque of different kinds of motors based on the principles of the direct-current motor and of the static transformer. In the present installment he takes up the direct-current motor and begins discussion of the polyphase induction type.—*Electrical Review*, Jan. 11, 1919.

Effect of Interpoles on Commutation of Direct-Current Machines.—R. L. WITHAM.—The author deals with the purpose of the interpoles. How they operate to effect commutation and how one interpole may be used in each pair of main poles to serve the same purpose as an interpole for each main pole are explained.—*Power*, March 4, 1919.

Lamps and Lighting

Fundamentals of Illumination Design.—J. R. COLVILLE.—The writer considers the fundamental principles in illumination design and gives several tables which should be useful in connection with laying out a lighting system. In these tables may be found the foot-candle requirements in various types of buildings, shops and offices, and data are given on types of lamps and reflecting units.—*Central Station*, February, 1919.

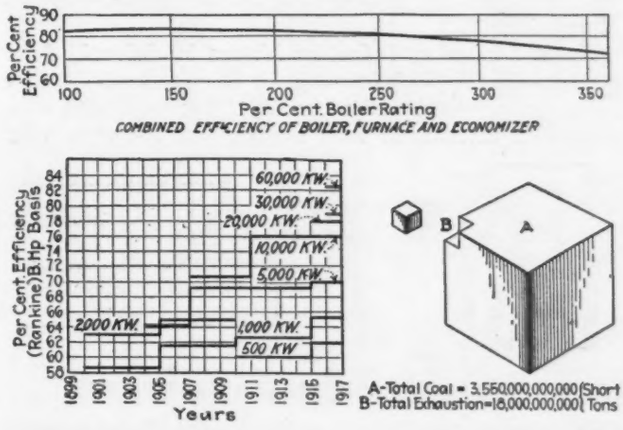
Generation, Transmission and Distribution

Calculation of Plant Efficiencies and Fuel Costs.—J. T. FOSTER.—The author presents two charts with which the engineer may readily determine the efficiency of boilers, evaporation and fuel cost per 1000 lb. of steam in mills per kilowatt-hour.—*Power*, March 4, 1919.

Logarithms of Hyperbolic Functions to Twelve Significant Figures.—FREDERICK E. PERNOT and BALDWIN M. WOODS.—The tables presented are given logarithms to the base 10 of the three principal hyperbolic functions, *i.e.*, the sine, cosine and tangent for the range from 0.000 to 2.000 with a tabular interval of 0.001 and auxiliary tables of log sinh x/x and log $x/\tanh x$ for the range from 0.000 to 0.500, with the same tabular interval as for the other tables. These tables were prepared primarily to fill a gap existing in Gudermann's tables of the logarithms of the hyperbolic functions. These tables should be useful in transmission line calculations.—*University of California Publications*, Nov. 16, 1918.

The Larger Undeveloped Water Powers of Tennessee.—J. A. FLETCHER.—In a comprehensive report on the undeveloped water powers of Tennessee the writer has given a number of curves showing the variation of stream flow and the drop in elevation along some of the streams in the state. Tables are also given in which water-power developments in various parts of the country are analyzed to show, among other things, what percentage of mean annual flow is required by the plant at its maximum capacity. The author states that within a radius of 80 miles (125 km.) of Knoxville the undeveloped water powers aggregate 800,000 hp. and within 50 miles (80 km.) nearly 700,000 hp. He also indicates many raw materials which can be used to advantage for chemical and metallurgical industries near this undeveloped water power.—*Proceedings American Electrochemical Society*, April 30, 1918.

Getting Better Economy in the Power House.—G. H. KELSAY.—The writer calls attention to the fact that substantial savings are possible in the boiler room by the use of some simple expedients which have been widely published in the technical press and in government publications. He shows what progress has already been made in improving boiler efficiency and gives curves



PROGRESS IN BOILER ECONOMY AND STATUS OF COAL SUPPLY

indicating what performances may be expected of boilers of various sizes at the present time. It is also shown that if the use of coal increases year by year as it has in the past the present supply will be exhausted in a period of about a hundred years. About one-half of 1 per cent of the available coal in this country has been used up to the present time.—*Electric Railway Journal*, March 8, 1919.

Development of Hydroelectric Resources in Eastern United States.—D. H. COLCORD.—The writer outlines in considerable detail the influences which have held back the development of water-power sites in this country. He also shows the urgent necessity for further development and outlines the advantages that may be realized

from the more extended utilization of water-power resources.—*Electrical Review*, Feb. 8, 1919.

Development of the Two-Phase-Three-Phase Transformation.—CHARLES F. SCOTT.—The author gives an interesting background, showing how two-phase-three phase transformation was developed.—*Electric Journal*, January, 1919.

Features of Three-Phase-Two-Phase Generating Station.—Additions to the Sheboygan company's plant are of interest on account of the fact that it involves three-phase-two-phase transformation.—*Electrical Review*, Jan. 18, 1919.

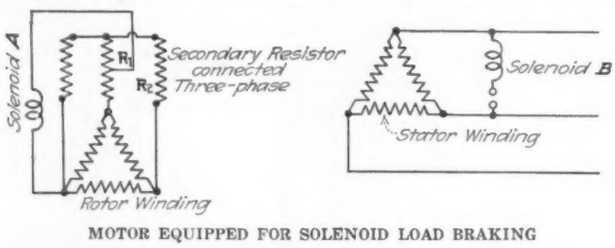
Installations, Systems and Appliances

Use of Electric Power in the Mining of Anthracite.—J. B. CRANE.—This paper gives figures for the power cost and energy consumption of anthracite mines and the reasons for these being in excess of the requirements of bituminous mines. Estimates are also given as to the additional coal that will be released by the electrification of the anthracite mines. Illustrations are included showing representative installations of electric drive.—*General Electric Review*, February, 1919.

Operating Details of an Electrically Operated Cement Mill.—The writer traces the progress of material through the mill and shows what apparatus and what size of machines are necessary for the various processes of cement manufacture.—*Electrical Review*, Feb. 8, 1919.

Electrically Welded Steam Lines.—H. R. WOODROW.—On account of the scarcity of extra heavy flanges during the war recourse was had to electrically welding a great length of 12-in. (30-cm.) steam pipe for the United States government explosives plant at Nitro, W. Va. The process is described in this paper.—*Power*, March 4, 1919.

Speed Control of Induction Motors by Solenoid Load Brakes.—R. H. MCLAIN and H. H. VERNON.—A few years ago practically all crane hoists were equipped with automatic mechanical load brakes, but to-day a very



MOTOR EQUIPPED FOR SOLENOID LOAD BRAKING

large number of cranes equipped with direct-current motors use dynamic braking instead. The development of the solenoid load brake for alternating-current wound-rotor motors makes possible the elimination on an alternating-current crane hoist of the more or less troublesome mechanical load brake. Practically the same speed-torque characteristics obtain with an alternating-current motor equipped with a solenoid load brake as with a direct-current motor with dynamic braking. There are only a small percentage of applications that cannot be met by either a multiple magnet brake, which gives two degrees of braking, or a solenoid load brake, which gives a variable amount of braking responsive to the speed of the motor with which it is used. The multiple magnet solenoid brake is made up in the form of one brake operated by two or more independent magnets. This brake is especially adapted for stopping apparatus which is moving in a horizontal plane. Where many varieties of load are to be lowered by the same hoist the solenoid load brake may be used. This brake consists essentially of an ordinary solenoid brake in which the solenoid is of such weight that very little braking action is obtained from the operating solenoid. But, in addition to this operating solenoid, there is another solenoid which is connected to the circuits of the rotor. If this second solenoid is de-energized, it applies heavier weight to the brake levers and consequently greater braking torque. If it is energized, its weight is almost raised from the levers and it exerts practically no braking torque. For intermediate values of excitation intermediate amounts of braking will be obtained. Since the voltage which is generated by the rotor of an induction motor varies directly as the slip of the motor, this arrangement is an ideal one, because when the motor is standing still a high voltage is induced in the rotor and consequently a small amount of braking would be obtained, whereas when the motor is running at high speed a low voltage is induced in the rotor and consequently a greater amount of braking is obtained.—*General Electric Review*, February, 1919.

Electrophysics and Magnetism

Conductivity of Sea Water.—H. R. RIVERS-MOORE.—The purpose of the investigation was to ascertain whether the resistance of sea water could be regarded for practical purposes as constant over a wide range of frequency and for very small current densities. The apparatus used in these investigations is fully described.—London *Electrician*, Feb. 7, 1919.

Note on Losses in Sheet Iron at High Frequencies.—MARIUS LATOUR.—In this article the author determines the power expended separately by eddy current and by hysteresis in a sheet of iron, on the assumption that there exists a constant angle of lag between the magnetic induction in the sheet and the magnetizing field producing it. He deduces the thickness which should be given to the iron sheets of an apparatus supplied by a high-frequency current in order that the total power expended shall be a minimum and then calculates the angle of lag between the voltage and the current in the circuit of an inductance coil.—London *Electrician*, Feb. 21, 1919.

Electrochemistry and Batteries

The Electron Spectrum of Iron.—It is said that while spectroscopic analysis has given an excellent means for the determination of high temperatures, such as in furnaces for the treatment of steel and iron, much care must be exercised in interpreting data of this sort. It has been shown that the iron spectrum depends on so many physical and electrical circumstances that considerable study must be devoted to this subject before the data can be interpreted with confidence.—London *Engineering*, Feb. 21, 1919.

Ionization and Resonance Potentials for Electrons in Vapors of Arsenic, Rubidium and Caesium.—P. H. FOOTE, O. ROYNLEY and F. L. MOHLER.—Two types of inelastic collision between the electron and atom occur in vapors of arsenic, rubidium and cæsium. The potential differences through which an electron must fall to attain sufficient energy or velocity to produce these collisions are known as the resonance and ionization potentials for the particular metal in question. Experimentally determined values of the resonance and ionization potentials for rubidium were 1.6 volts and 4.1 volts respectively; for cæsium, 1.48 volts and 3.9 volts respectively; for arsenic, 4.7 volts and 11.5 volts re-

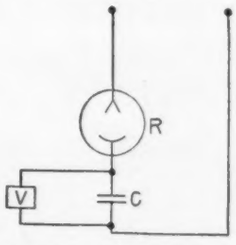
spectively. No ionization whatever could be detected at the resonance potentials of rubidium, cæsium and arsenic.—*Physical Review*, January, 1919.

Effect of Lithium Upon the Capacity of the Edison Storage Battery.—L. C. TURNOCK.—Experiments upon a very small cell are described in which the electrolyte consisted of a 21 per cent solution of caustic potash and varying amounts of lithium hydrate. These amounts were 10, 20, 30, 40 and 50 gm. per liter. In the commercial cells it appears that the last-named quantity is employed. It was found that although the lithium hydrate increases the internal resistance, it also increases the available capacity. This increase amounted to 12 per cent (with an increase of 21 per cent in the resistance) by the addition of 50 gm. of the hydrate.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Transactions A. E. S.*, 32, 1917.)

Units, Measurements and Instruments

Industrial Reconstruction and the Metric System.—HARRY ALLCOCK.—The writer points out that there are many objections to the adoption of the metric system in Great Britain: (1) It is already permitted to use it side by side with the British systems, which should lead to the survival of the better system in the long run; (2) the obligation to supply their part in the renewal of machinery made to British measurements prevents British manufacturers from now adopting the metric system; (3) the opposition of the textile trade; (4) if the metric system should be adopted at this time the British would be at a disadvantage in competition with Germany; (5) the United States and many other countries still use the British system.—London *Electrical Review*, Jan. 17, 1919.

Measurement of the Crest Voltages.—J. R. CRAIGHEAD.—An ingenious arrangement of kenotron, condenser and voltmeter which has been developed for measuring the crest values of alternating voltage embodies in



CIRCUIT OF RECTIFIER, CONDENSER AND VOLTMETER

one instrument a combination of good qualities not possessed by previous devices for the purpose, according to the author. The theory and construction of the crest meter may be understood from the diagram, in which a valve type of rectifier is connected in series with a condenser of negligible leakage. The condenser is charged to a voltage dependent upon the crest valve of the voltage wave and cannot be discharged through the rectifier. A voltmeter which does not draw current measures the condenser voltage. Tests of the accuracy of this device are recorded, and its advantages and limitations set forth in this article.—*General Electrical Review*, February, 1919.

Checking Calibration of Thermocouples and Pyrometers.—After stating the desirability for accuracy in furnace and other high-temperature measurements, the writer suggests the following equipment for carrying on systematic testing: The method provides for the maintenance of standards of temperatures in the plant and for convenient comparison of these standards with the works instruments. The standard of temperature for the works should, it is said, consist of at least one platinum/platinum-10 per cent-rhodium thermocouple calibrated by the Bureau of Standards and a potentiometer. While one platinum couple does suffice, it is most desirable that three platinum couples be available for comparison, one against the other. If one couple only is available, such change will not be manifest to the operator until the damage due to faulty temperature determinations has been done. The writer also discusses the sources of error in thermocouples and pyrometers, and remedies. The choice of calibrating equipment and directions for setting up and using the thermocouple checking equipment are given.—*Electrical Review*, Jan. 11, 1919.

Telegraphy, Telephony and Signals

Multiplex Telegraphy and Telephony.—In this paper is found a description of the means by which five telephone conversations and two telegraph messages may be transmitted over one pair of wires at the same time.—*Wireless Age*, March, 1919.

The Weagant Oscillation Valve.—In this article a description is given of the improvements made by R. A. Weagant on the original Fleming oscillation valve. The physical constructions and diagrams of connections, showing the use of the Weagant valve, are given in this article.—*Wireless Age*, March 1919.

Wireless Telegraphy in the French Colonies.—G. ALIX.—An article abstracted from the *Economiste Français*. Outside of the mother country there are thirty-five French radiotelegraphic stations in service, twenty-five in course of construction and twenty others projected. These include installations in Algeria, Madagascar, the Congo, Timbuctoo, Indo-China and the other colonies. The author holds that the still unexecuted project of circling the globe by a chain of wireless posts in French territory, reaching from the South of France and Tunis to the Marquezas Islands, thence under the Pacific to Central America and Martinique, is quite feasible. The Eiffel Tower sometimes receives signals from Panama, San Francisco and Honolulu, and it makes itself heard in New Zealand.—*Revue Générale de l'Electricité*, Feb. 8, 1919.

Propagation of the Current in a Telegraphic Line.—J. B. POMEY.—Article concerning the integration of the "telegraphers' equation." After recalling the general principles affecting the case of variable emf.'s, illustrating them by a simple example, the author demonstrates the formula of Heaviside, known as the theorem of development, and gives a more general formula applying to cases where the system does not start from a state of repose.—*Revue Générale de l'Electricité*, Feb. 8,1919.

Miscellaneous

Electricity on Dairy Farms.—The value of good lighting and ventilation in stables of dairy farms is pointed out.—*Electrical Review*, Dec. 28, 1918.

Extensive Use of Electricity for San Francisco Harbor.—Among the uses for electricity at the San Francisco Harbor are included pier, dock and street lighting, an electric system, harbor lights and fog signals, fire-alarm and telephone system. The electric repair and maintenance service is also described.—*Electrical Review*, Dec. 28, 1918.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities
in the Technical, Commercial and
Manufacturing Fields

ELECTRICAL MANUFACTURERS' EXPORT ASSOCIATION FORMED

Thirty Manufacturers Join New Organization to Handle Non-Competing Lines in Export Markets— F. E. Watts Is President

The Electrical Manufacturers' Export Association of the United States of America was formally organized at the Hotel Manhattan, New York, on Tuesday of this week.

A preliminary meeting of the manufacturers was held at the University Club, New York, on Feb. 27, and a plan for the organization of the association was outlined by F. E. Watts. A committee was appointed to draft the constitution and by-laws and to incorporate such an institution under the New York laws. This was done and the constitution and by-laws were adopted at the meeting this week. At the same meeting the following officers were elected: President, F. E. Watts of F. E. Watts, Inc.; vice-president, H. H. Cudmore of the Argus Lamp & Appliance Company; treasurer, D. R. G. Palmer of the A. A. Wire Company; secretary, W. B. McCurdy of the Good Manufacturing Company.

A board of nine directors, who will act as the governing body of the association, also was chosen. This association is for membership only and is composed of electrical manufacturers in non-competing lines. Its purpose, as stated in the constitution, is as follows:

(a) By coöperative effort to facilitate the exportation of electrical apparatus, appliances and materials, as manufactured by the several members of the association, from the United States to foreign countries.

(b) To investigate the commercial conditions in foreign countries as affecting trade, to secure all data, statistics, samples of competitive goods and prices of same, to enable the members of the association to compete more intelligently for trade in foreign markets.

(c) The protection and perpetuation of trademarks of the members in foreign countries and the maintenance of a line of direct contact and service plan from maker to user.

Over thirty prominent electrical manufacturers have joined the association, and a number of others have applied for membership. A roster of manufacturers who are already members is being prepared and will shortly be ready for publication.

The primary object of the association is to consolidate the export work of the several members, to investigate the possibilities of sales and to develop foreign interest in the electrical products of the manufacturers, while, on the other hand, giving to the foreign buyer a complete line of electrical products from one source, so that he may make his purchases with one selling agency rather than a great many.

F. E. Watts, Inc., New York, has been made the selling representative for the individual members of the association, and all sales will be conducted through its organization. This company has already established agencies in the Scandinavian countries, Holland, France, Italy, Rumania, Spain, South Africa, China and Japan and will have its own branches in England, Australia, New Zealand, Cuba and Mexico. F. E. Watts will start in April for a three months' trip to Europe, making a personal investigation of the possibilities of sales.

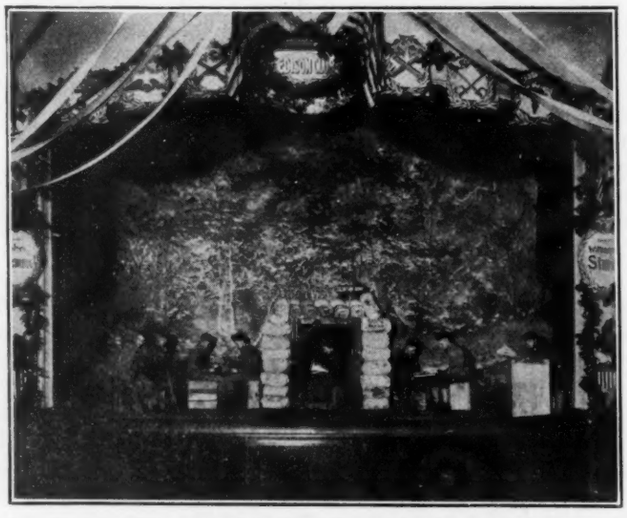
TELEPHONE RATE CASE IN THE SUPREME COURT

Highest Tribunal Gives State of Kansas Permission to Institute Original Proceedings to Test Authority of Postmaster-General

A decision of the United States Supreme Court, rendered on March 17, gives the State of Kansas permission to institute original proceedings against the Postmaster-General to test whether he has power to make rates under the order of Dec. 13. A return in the case was ordered to be made at the next term of the court in October. The question involved concerns the various states whose authorities have contested the increase in telephone rates.

In taking the suit to the highest court the Kansas authorities contended that the Postmaster-General is without authority to fix the rates and that so far as such authority was apparently granted by the resolution of Congress and the proclamation of the President it was unconstitutional.

The Boston Edison Company Welcomes Returning Service Men



Several hundred employees of the Boston Edison company assembled at the Welfare Buildings of the company on the evening of March 10 to welcome home Edison men returning from military and naval service. The feature of the evening was a series of "Victory" tableaus under the direction of L. D. Gibbs, superintendent of the advertising department. Nearly 500 of the company's approximately 2000 employees entered the service during the war, about twelve of whom made the supreme sacrifice.

BUSINESS DURING 1918 OF WESTERN ELECTRIC COMPANY

Rapidly Increasing Costs of Production Resulted in Lower Rates of Profit—Report of President H. B. Thayer

Details of operations of the Western Electric Company, Inc., in 1918 are given in the report to stockholders. Total sales for the year were $145,226,000 as compared with $150,340,000 in 1917, $106,987,000 in 1916 and $63,852,000 in 1915. Of the total $67,860,000 were to associated Bell telephone companies, $21,825,000 were to the United States War and Navy Departments, and $55,541,000 to other customers.

H. B. Thayer, the president, reports that the net earnings, after meeting the high costs of labor and material prevailing throughout the year, after writing down the inventory at the end of the year on account of the decreasing values of materials then on hand, and after providing for the very heavy taxes and for other necessary reserves, amounted to $5,050,849. This is 6 per cent on the average investment for the year, $84,600,000. Mr. Thayer adds:

The rapidly increasing costs of production which we experienced in common with other manufacturers during the year resulted in lower rates of profit than usual on our own standard products. This was offset only in part by increased selling prices.

On our contracts with the government final settlement has not at this date been made, but it is expected that the net earnings when definitely determined will be about 5 per cent on the sales.

Our net earnings on our other manufactures and on our sales of merchandise not manufactured by us were satisfactory.

No return from foreign investments has been included in our earnings for 1918 (our information thereon being incomplete). It is believed, however, that the earnings of some of the foreign allied companies in which we are interested were sufficient to offset losses on others, so that no net loss was sustained on the whole.

The Antwerp factory, which had been in the hands of the Germans throughout the war, came again under our control in November, 1918. Although the buildings were not much damaged, it is necessary to replace large amounts of machinery and material which had been taken away by the enemy. This rehabilitation is now in progress, and it is expected that operations will be resumed there within a few months.

For the purpose of handling our export business to the best advantage it has been found advisable to segregate it from the domestic business directly conducted by this company. Accordingly, a subsidiary corporation, the International Western Electric Company, Inc., was organized during the year and has been operating since June 1 with satisfactory results.

Mr. Thayer then takes up the prospects for business and indicates that additions to plant will bo continued. He says:

The unfilled orders of your company at Dec. 31, 1918, after deducting those canceled or likely to be canceled by the government because of the cessation of hostilities, aggregated about $26,265,000, a decrease of $2,491,000 as compared with Dec. 31, 1917. It is probable that the total sales in 1919 will be considerably less than in 1918, although active efforts are being made to stimulate our trade and to develop new business.

During the immediate period of adustment to peace conditions, of falling prices and of uncertainty in every direction, we must expect unusual variations from our normal business, but it seems reasonable to look forward to a resumption of activity in manufacturing and trade at no distant date. We are continuing the additions to our shop buildings and equipment which were started last year, in the expectation that by the time they are completed we shall be able to get enough business to fill them.

The additions to plant during 1918 aggregated $2,925,000 while the increase in reserve for depreciation on plant was $2,139,000. In addition to providing for the depreciation of plant according to our usual and normal practice, the excess costs of construction in process under war conditions over the normal costs to be expected under peace conditions have been charged off.

Regarding other matters, the report says:

The merchandise on hand Dec. 31, 1918, was inventoried as shown on the balance sheet at $45,047,000. In arriving at this valuation, the principal raw materials have been taken at their market cost on March 1, 1919, which include copper at 15¼ cents per pound and lead at 4.7 cents per pound. Overstocks of various finished and partially finished articles have also been carefully depreciated, and in addition the sum of $1,000,000 was carried into the reserve for contingencies. Various charges against this reserve, chiefly for patents purchased and for contributions to war relief organizations, have, with sundry adjustments, amounted to $349,299, resulting in a net addition to this reserve of $650,701 for the year.

Our Hawthorne shop force at the end of the year was 17,021 employees, as compared with 21,549 at the beginning of the year. The total number of employees at Dec. 31, 1918, was 26,126.

The number of employees who entered the military and naval forces of the United States was 5881. Of these our latest information shows forty-one lost their lives and thirty-seven were wounded. Up to March 1, 1919, 1443 had been honorably discharged and had applied for reinstatement, of whom 1259 had been reëmployed and the remainder are to be given employment as soon as the conditions of the business make it possible. In the meantime, their rights under the employees' benefit plan are preserved to them.

The payments from the employees' benefit fund during 1918 amounted to $258,184 and were made to 3673 beneficiaries, including pensioners, who numbered ninety-two at the end of the year.

The company has continued its long-established policy of using its credit with its regular bankers to finance expanding stocks of merchandise and unusually large accounts receivable whenever necessary because of increased business. Its general bills payable amount to $10,600,000, which was the amount outstanding at the end of the previous year. To March 1, 1919, these bills payable have been reduced to $8,100,000, and it is expected that the decreasing volume of sales will make further reduction possible during 1919.

In addition to these general bills payable there were outstanding at Dec. 31, 1918, the company's notes for $2,172,250, incurred for the purchase of Liberty loan bonds, mostly for account of employees who are paying for them in monthly installments, and this amount is being reduced accordingly from month to month; 92.7 per cent of the company's employees subscribed to the third Liberty loan and 98 per cent to the fourth Liberty loan.

The engineering staff and laboratories of the Western Electric Company, Inc., have been devoted during the year almost entirely to activities in connection with this country's participation in the war.

Earnings of the company for 1918, including the owned subsidiaries, Western Electric Company, Inc., of Delaware, and Western Electric Company of California, follow:

Sales		$145,226,119
Other income		664,919
		$145,891,038
Cost of merchandise	$128,219,691	
Expenses	9,999,965	
Taxes	1,520,533	
Appropriated for:		
Reserve for employees' benefit fund (subsidiary companies)	100,000	
Reserve for contingencies	1,000,000	140,840,189
Available for interest and dividends		$5,050,849
Interest paid	$1,540,528	
Dividends	3,300,000	
Carried to common stock	210,321	$5,050,849

Good Meeting of A. I. E. E. in Boston

Importance of Railroad Electrification as a Means of Conserving the National Fuel Resources—Secretary Lane's Super-Power Project Favored—Telephone Receiver Theory —Raising the Plane of Engineering Education

IN THREE intensive sessions at the Copley-Plaza Hotel, Boston, Mass., on March 14, the 348th meeting of the American Institute of Electrical Engineers covered a wide range of subjects. About 300 members and guests were on hand Friday morning to receive a cordial welcome from Governor Calvin Coolidge of Massachusetts, and from the time President Adams called upon the first speaker to the closing words of the educational session following the banquet Friday evening the program was packed with interest.

In the morning session Calvert Townley, Westinghouse Electric & Manufacturing Company, read a paper upon the possibilities of steam railroad electrification, which was followed by a discussion in which practically all speakers affirmed their belief in the extension of electrical service in many special cases in the not distant future. Fuel saving received much attention as a by-product of the discussion. In the afternoon problems of the telephone receiver were considered, with contributions by Dr. A. E. Kennelly, H. Nukiyama, Dr. A. G. Webster and others, with a protracted technical discussion. At the banquet in the evening President Adams officiated as toastmaster, and a brilliant discussion of engineering education and the relations of the scientist to the engineer was enjoyed. The speakers were Prof. H. E. Clifford of the Harvard Engineering School, Prof. E. B. Wilson of the Massachusetts Institute of Technology, President Emeritus Charles W. Eliot of Harvard University, Dr. Arthur Gordon Webster of Clark University, and Dr. Saul Dushman of the General Electric Company's research laboratory, Schenectady.

An enjoyable luncheon was given to the board of directors and guests Friday noon at the Copley-Plaza by the members of the executive committee of the Boston Section of the Institute, a feature of this occasion being the exhibition of the tablet to W. D. Weaver, former editor of the ELECTRICAL WORLD, which is to be placed in the near future in the directors' room at the Engineering Societies Building, New York, in appreciation of Mr. Weaver's great services to the American Institute of Electrical Engineers and to the progress of electrical science.

ELECTRIFICATION SESSION

The electrification session opened with a paper on "Some Possibilities of Railroad Electrification as Affecting Future Policies," by Calvert Townley, Westinghouse Electric & Manufacturing Company, New York. The war has retarded development, but as railroad conditions become more settled there is ground for hoping that electrification can again be studied on its merits. The author stated that the various systems of electrification agree on fundamentals. All offer the possibilities of unlimited electric power, which means longer trains and higher schedule speeds. Once the railroads escape from the financial Slough of Despond and are again able to get capital there will not be enough engineers or electric factories in the country to serve them.

Frank H. Shepard, Westinghouse company, said that every "hard-shelled" railroad man will concede that electrification means better service and a better railroad, that transportation service is the greatest railroad problem to-day, and that the development of the United States is dependent upon adequate transportation. Electrification will enable double the traffic of a railroad to be handled with the same or virtually the same plant in roadway and tracks; it is a tool and offers practically unlimited power for transportation service.

W. S. Murray, consulting engineer, New York City, expressed high appreciation of Mr. Townley's paper, with which he was in full agreement. He pointed out that in future a composite railroad-electrical man will be needed to meet electrification requirements properly—a man with one eye for railroad and the other eye for electrical conditions.

Mr. Murray then discussed at some length the project of Secretary of the Interior Lane to develop a system of trunk-line power supply for the Atlantic seaboard district from Boston to Washington.

W. B. Potter, chief engineer of electric traction, General Electric Company, contributed a written discussion pointing out that electrification operated from hydraulic power offers the only known method of conserving our limited supply of coal and oil. Even when hydraulic power is not available, a saving of over two-thirds of the fuel and much of the fuel haulage can be obviated by the erection of steam-power plants suitably located and furnishing electrical energy from the coal burned in modern practice.

The coal and equivalent oil used on the steam locomotives of the United States in 1914 totaled 140,000,000 tons. The ton-miles moved in the same period, excluding the tonnage of locomotive tenders and 75 per cent of the railway coal, amounted to 930,000,000,000. If the same tonnage had been moved electrically, basing figures on an energy consumption of 40 watt-hours per ton-mile, the annual energy consumption would have been 37,200,000,000 kw.-hr. If this energy had been obtained from steam-power houses at 2.2 lb. of coal per kilowatt-hour, instead of the 140,000,000 tons actually used there would have been required 40,000,000 tons of coal. This shows a net saving of 100,000,000 tons in one year. A still greater saving would have been accomplished in proportion to the amount of hydroelectric power available.

If the tonnage moved in the United States on steam railroads could have been handled by the expenditure of 37,200,000,000 kw.-hr., this would be equivalent to an average load of 4,250,000 kw. This is not an exorbitant amount compared with the power plants already installed. In 1917 the power-station capacity in the United States, including central stations, electric railways and isolated plants, was about 20,000,000 kw. Thus there is installed electric power-station capacity equivalent to four or five times the power which would be required for operating all the railroads in the United States electrically.

The further development of central-district stations

with either fuel or water as their source of power will afford the most direct means of conserving coal. The existence of such large central stations at strategic points throughout the country, even if primarily installed for railway use, would of itself further and develop the use of electricity for various industrial purposes, and by so doing would affect the coal consumption more widely than the item of railway coal alone.

George Gibbs, chief engineer Pennsylvania electrification, New York City, also presented a written discussion. He maintained that it is most important to combine the advantages of electric operation with improved railroad practice and that something besides the purely electrical specialist is needed to solve such problems. The question has really now changed from technical to financial feasibility. The attention of our government was directed in the war toward the electrification of railways as a possible way of increasing their capacity for emergency service; also as a means of fuel conservation. It may be that some important electrical projects in this way would have been launched as war measures, especially as results and not costs were all-important.

N. W. Storer, Westinghouse company, Pittsburgh, expressed keen appreciation of Mr. Townley's paper. He felt that the ultimate results of electrical operation are too broad for present vision; that years of evolution will follow the initial development. The opportunities of the future are very great, and all that need be considered at present are cases where the need for electrical operation is a crying one, as in the case of tunnels, large terminals, etc.

The speaker characterized Mr. Murray's vision of a super-power supply system as most inspiring and easily within the range of possibilities. He contended that we owe it to future generations to conserve natural resources. The need of being open-minded on these problems is large. The cost of electrification is large, but compared with the expenditures of the fighting nations for destruction during the war, it is far less large in appearance than before. The United States spent in four or five days of war enough money to electrify all the terminals in Chicago. "Why, then," said the speaker, "should we hesitate to spend money for such a constructive improvement as electrification?"

Major George F. Sever, New York, spoke briefly of the importance of fuel conservation on the Pacific Coast, where coal is an almost unknown quantity. Oil and water are there the chief sources of electrical energy. The railroads are now using about 40,000,000 barrels of oil yearly and the public utilities of California 1,000,000 barrels. The United States shipping now needs 30,000,000 barrels yearly, and other users in California consume 40,000,000 barrels per annum. California produces 110,000,000 barrels of oil yearly, compared with 350,000,000 barrels in the entire country, 42 gal. per barrel. Hydroelectric power development is therefore absolutely necessary in California for both railroad and public utility operation. In 1914 oil cost 40 to 50 cents per barrel; it is now $1.60 at the California wells and at some other points on the Pacific Coast is $1.85.

More than $3,500,000 can easily be saved in California yearly by interconnection and hydroelectric supply; the mountain passes are well suited to electrical operation of trains, and the increasing scarcity of oil deserves close consideration. In closing, Major Sever commended the fuel-saving work done in New England during the past year and pointed out that there is little if any surplus of water power available for exportation from this section of the country as at present developed.

Carl Schwartz, electrical engineer, New York Central lines; John Murphy, electrical engineer, Department of Railways, Ottawa, Can., and Dr. Arthur Gordon Webster, Clark University, Worcester, Mass., also contributed to the discussion.

Prof. Charles F. Scott, Yale University, then introduced a resolution indorsing Secretary Lane's "superpower" project, and it was unanimously voted that the board of directors prepare and transmit it.

TELEPHONE SESSION

Dr. A. E. Kennelly of Harvard University and H. Nukiyama presented a paper on "The Electromagnetic Theory of the Telephone Receiver," in which the mmf. and flux and the diaphragm vibratory displacement in the magnetic field were taken into account, carrying the mathematical investigation further than certain previous papers on the subject have done. The theory is based upon the motional impedance circle. The motional power is shown to be derived partly from the testing alternating current and partly from changes in the magnetic circuit. Previous papers on the motional impedance circle failed to reveal the power expended parasitically (by both hysteresis and eddy currents) in the magnetic circuit.

The authors sought to supply this omission and thus to offer a closer approximation between the theory and the observed behavior of the telephone receiver as an electromagnetic motor. The theory was presented with relation to a series of impedance measurements already published on a particular Bell bi-polar receiver. The small amplitude and single frequency of the current applied establish various limitations to the new theory, which were outlined by the authors. According to the theory, however, the changing of the winding of a receiver, other things being equal, increases the mechanical output at resonance in proportion to the resistance, for a fixed excitation, but for a given amount of I^2R power loss in the winding this mechanical power output remains substantially constant.

An illustrated lecture on "The Absolute Measurement of the Intensity of Sound" was then given by Prof. A. G. Webster of Clark University. Dr. Webster exhibited an apparatus in which, by utilizing the principle of the interferometer, the performance of any type of horn can be predicted and sound standards established. By the Webster phonometer actual force values can be given to sounds hitherto unmeasured; the absorption of fabrics can be studied, and telephone receiver performance analyzed. To produce the pure tones desired in demonstration, a quartz bar was used instead of a steel tuning fork. By this apparatus the pressure of air corresponding to a millionth of an atmosphere can be measured over a range of about two octaves. Dr. Webster said that in recent experiments he had determined the coefficient of sound reflection from the ground to be about 95 per cent.

The foregoing paper and lecture were discussed by J. B. Taylor, General Electric Company; Dr. R. L. Jones, Western Electric Company; H. S. Osborne, American Telephone & Telegraph Company, T. E. Shea and H. Nukiyama. Dr. Jones derived the following equation of gross efficiency for the telephone receiver, where μ_{12} represents the true efficiency; Z_{1m} the motional impedance at any frequency stated; B_{12} the force-factor;

b_3 the mechanical resistance; B_1 the free resistance of the driving circuit:

$$\mu_{13} = \frac{Z_{1m}^2}{(B_{13}^2/b_3)B_1}$$

At resonance, this reduces to about $\mu_{13} = Z_{1m}/B_1$.

Dr. Jones also described various tests with a special receiver having a Portland cement case, laminated core pieces and high-resistance diaphragm. This outfit had such a small eddy-current displacement that the angle β (mean angle of lag in degrees between magnetic flux and mmf.) was only 1 deg. to 2 deg. When a small coil was wound near the pole tips of the receiver the angle β graphically determined was 25 deg. and the calculated angle was 23.5 deg. With two parallel windings on another receiver with large eddy-current losses the angle of lag was 65 deg.

Mr. Osborne pointed out that electrical engineers prefer to read indications on electrical instrument scales to measuring mechanical displacements. Dr. Webster defended the simplicity and accuracy of his equipment, which has a dampening coefficient as low as 1.5. This, Dr. Kennelly declared, represents an experimental miracle. Mr. Nukiyama called attention to the similarity of results reached by Dr. Jones's analysis of telephone receiver efficiency to those of himself and Dr. Kennelly. Mr. Shea touched upon the limitations of the new theory of Dr. Kennelly and Mr. Nukiyama.

EDUCATIONAL SESSION

"The engineer is to be even more important in peace than he was in war," declared President Adams in opening the evening session. The necessity of high-grade training for engineers was recognized by all the speakers, the first of whom, Prof. Harry E. Clifford of the Harvard Engineering School, discussed "Science and the Engineer." A résumé of Professor Clifford's remarks is printed elsewhere, a notable feature of his address being a plea for the realization of higher ideals in engineering education, with less opportunism and more real encouragement to the younger instructors and assistant professors, many of whom are shockingly underpaid in comparison with the compensation accorded in ordinary trades.

In introducing the next speaker, Prof. E. B. Wilson, head of the department of physics, Massachusetts Institute of Technology, President Adams maintained that about 75 per cent of the men who come to our engineering schools do not belong there. "Our whole educational system 'just happens'," he said. "Is there not some method by which the men who come to our engineering schools can come by right of intellectual power and not by right of pocketbook?"

Professor Wilson gave a whimsical talk on "Mathematics and the Engineer," discussing the evils of "the rigors," a disease which breaks out in the educational body politic where a desiccated and rigid philosophico-mathematical curriculum is followed. The speaker stoutly defended the average student and maintained that attempts to give a post-graduate type of instruction to the great run of student minds are needless as a part of the training of the engineer. Without attacking post-graduate educational methods in their proper place, the speaker pointed out that if super-engineers were needed to any extent there would be a corresponding demand for "super-instruction." The great importance of practical problems in engineering mathematics was emphasized.

"We have 860 freshmen at Massachusetts 'Tech' this year," said Professor Wilson, "and you can't make 500 good engineers in one year. Could your engineering profession absorb 500 budding Lord Kelvins if you had them?" Professor Wilson pointed out that the greatest living superman to-day in electrical engineering is Oliver Heaviside, whose great talents, however, are not readily utilized in the world of affairs. The demand is strong to-day for men who can handle others.

PRESIDENT EMERITUS ELIOT PAYS HIGH TRIBUTE TO THE ENGINEERING PROFESSION

Dr. C. W. Eliot, president emeritus of Harvard University, was then introduced. He spoke at length on "University Training for Engineers," emphasizing the importance of maintaining educational continuity in families as well as giving opportunities to individuals who cannot look back along an unbroken line of culture and training. The advantages of looking to teachers for results rather than specifying or ordering methods in detail were touched upon. A medical teacher recently stated that the standards of medical education have suffered during the war, as Professor Clifford had deplored with regard to engineering education. On account of the rigidity of military training it has been unfortunately the case that in a vast number of instances the military commanders have not known how to utilize the services of engineering specialists in their commands.

Dr. Eliot felt that American army officers as a class have received insufficient scientific training. It is a great public disaster that at this moment no provision has been made for maintaining an army with men adequately trained from the scientific standpoint. Dr. Eliot said that there is a small demand for engineers of the first-class type, but that demand must be met. How to do this is one of the most important problems of American universities and teachers. As Lowell has said, unless a democracy develops the highest type of men it will fail. Scholars, research men and geniuses of the highest type must be developed. The real need is to change completely from bottom to top the methods of instruction in the elementary and secondary schools. The speaker commended the use of practical problems in mathematical teaching, along the lines utilized in the Lincoln School, New York City. He said that the profession of teaching has grown less attractive, partly because of the relatively small remuneration now accorded. University training is desirable for boys who are to become engineers of the first order. These need modern languages, economics and government as well as the highest special training. The engineer needs contact with people, to learn how to deal with men. The great engineer should possess these human sympathies; his power over human beings is great, and in addition to sympathy with their motives he must be able at any rate to inspire the leaders of the working multitudes.

"We are threatened with a great degradation," said the speaker, "in limitation of output. I attach no importance to threats of violent socialism in this country, but I look with grave disquiet on voluntary restriction of production."

Dr. Eliot said that engineers need to know how to tell corporation employers the way to overcome these evil tendencies. The need of persuasive powers on the part of engineers is very great. An immense change for the better has come over American industry in the

past half century. The increased power exercised over nature by the engineer is extraordinary, and in the coming years this is to be extended greatly. Despite the shortcomings of our airplane program, airplane progress was really only started when the war closed. An enormous field of opportunity and usefulness lies ahead of the engineer. Engineering is the most serviceable of all the professions in raising the comfort of the people as a whole, in facilitating the pursuit of happiness. Closing, Dr. Eliot said that engineering used to be considered a materialistic profession, but that he knew of no profession which involves a greater use of the imagination and what may be called truthfulness of mind.

Dr. Arthur Gordon Webster, Clark University, Worcester, Mass., then gave an address on "The Place of Science in Engineering." He instanced various cases where the knowledge and training of the expert physicist had proved of great value in workaday affairs. Dr. Webster cited the success of the German long-range gun as an example of the value of theoretical knowledge, and pointed out various war demands for physical laboratory experts' services, notably in connection with the design of guns, calculation of trajectories and other mechanical problems. The speaker closed with a strong plea on behalf of the highest technical education and the maintenance of graduate courses for qualified men.

Dr. Saul Dushman, General Electric Company research laboratory, spoke briefly on the value of ideals and the importance of cultivating breadth of imagination in research work. There is a great dearth of men trained to research. In such work it is the frame of mind rather than the problems themselves that is of paramount importance. Inspiration cannot be regulated by rule of thumb. The joy in solving the problem must be a labor of love in which there is an intellectual and spiritual pleasure because some new light has been cast upon the infinite variety of nature's secrets.

In a paper for the educational session which was not read in the absence of the author, B. G. Lamme, Westinghouse company, the great importance of more thorough fundamental training was emphasized.

RAISE THE STANDARD OF ENGINEERING EDUCATION

Professor Clifford Declares Too Much Opportunism Exists in Present Methods of Instruction and Advocates Higher Plane of Technical Pedagogy

A vigorous plea for the establishment of higher standards in engineering education was made by Prof. Harry E. Clifford, Gordon McKay professor of electrical engineering at the Harvard Engineering School, at the three hundred and forty-eighth meeting of the American Institute of Electrical Engineers, held at Boston March 14. He pointed out that complacency has always been a foe to progress and that during the war there has been a distinct lowering of engineering educational standards through attempts to substitute hasty "intensive" training for logical, well-planned work. This training, Professor Clifford declared, might fit a man to go "over the top" and meet a fair measure of the military needs of the time being, but it by no means suffices for the production of first-rate engineers. The man who goes over the top possesses qualities that entitle him to all praise, but these are not necessarily the qualities which fit him to solve the complex problems of present-day civilization.

Professor Clifford said that it is going to be difficult to put engineering education back upon its proper plane. For many years the standards have been set by the needs of intellectual mediocrity—the educator has dealt with the lump and not with the leaven. The time has come to consider the needs of men of superior intellectual power. The result of catering to the man of "middle-low" power is to fail to bring forward the great engineer through high-grade engineering education. With the ordinary lump of mediocrity it is impossible to insist on the importance of fundamentals. Teachers are apt to relax in the face of the pressure of numbers and the insistence that quantity counts for so much. The responsibility is partly that of the instructor and partly that of those higher up. As a result engineers capable of broad work are not being turned out. There is a lack of historical background; our engineers are too much men of trial and error, not those who think out the problem ahead. The idea seems to be that if the result is secured, that is all-sufficient. Whether it is the best result does not count.

"The engineer should be able largely to eliminate needless trials," said Professor Clifford. "A prominent educational leader said to me not long ago: 'I train my engineers to *do*, not *think*.' 'I should adopt a slogan, then, if I were you, "Do not think!"'" said Professor Clifford. The time is here to do something for the abler men. In so doing the plane of education will be raised for all. It is entirely unjust to expect young assistants to enter teaching at salaries of $500 a year, to maintain a cultivated standard of living, marry and raise families on pay often below that of a rivet boy at a shipyard. To drive such men to pot-boiling—to tutoring, which is worse—is pitiful, the speaker said. It is the task of the leaders of the educational world and of the engineering profession to see to it that standards are raised.

Electric Furnaces for Mexico

Electric furnaces, it is said, are destined to be one of the chief items of electric export from United States to the Spanish-speaking countries. This is true because of the large amount of low-priced scrap metal there available and because of the abundant supply of hydroelectric power in most of these countries. Ten Bailey brass furnaces are here shown partly ready for shipment to Mexico. The furnaces are of the tilting type and are rated at 105 kw., 1500 lb. hearth capacity and 600 lb. per hour melting rate.

MEETING TO DISCUSS THE ENGINEER AS A CITIZEN

Three Associations Unite to Hold a Symposium on This Topic and Invite Other Societies to Participate

An "engineers' symposium" will be held on Wednesday, March 26, at 8 p. m., in the auditorium of the Engineering Societies Building, New York, under the general auspices of the local sections of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the Society of Automotive Engineers. The members of the following societies are cordially invited to participate:

American Institute of Electrical Engineers, American Society of Civil Engineers, American Chemical Society, American Electrochemical Society, American Institute of Chemical Engineers, American Society of Heating and Ventilating Engineers, American Society of Refrigerating Engineers, Brooklyn Engineers' Club, Illuminating Engineering Society, Institute of Radio Engineers, Municipal Engineers of the City of New York, Société de Chimie Industrielle, Society of Chemical Industry and Society of Naval Architects and Marine Engineers.

Gano Dunn will preside, and the following addresses will be made:

"The Civic Responsibility of the Engineer," Philip N. Moore; "The Relation of the Engineer to Legislation," Calvert Townley; "The Relation of the Engineer to Administration," Nelson P. Lewis; "The Relation of the Engineer to Public Opinion," Spencer Miller; "The Relation of the Engineer to Production and Distribution," Comfort A. Adams.

To secure constructive suggestions for the several committees on development a general discussion will follow the addresses.

HEARINGS ON AMENDMENT OF ILLINOIS COMMISSION LAW

Eighty-seven Cities Represented at Springfield Hearing in Support of Bill Giving Cities Home Rule of Utilities if They Desire

Further hearings before the Senate committee on public utilities of the Illinois Legislature were held at Springfield on Tuesday of this week on the bills amending the public utilities law and especially the Home Rule Municipal League bill giving cities the power to elect by ordinance and referendum whether they will come under the Public Utilities Commission or govern their own utilities.

Two hundred and six mayors, city attorneys and aldermen, including thirty aldermen from the city of Chicago, appeared, representing eighty-seven cities, in support of this bill. Numerous speakers addressed the committee on the desire for home rule and criticised the action of the commission in a number of instances. No attempt was made to discuss the provisions of this bill, and the hearing was adjourned until March 26, at which time the proponents were informed that they would be expected to discuss the bill section by section. The chairman further said that before any action was taken the Public Utilities Commission would be requested to appear and advise the committee relative to the criticisms and charges made by the speakers.

At the hearing before the House committee on Wednesday of this week, a sub-committee of eleven was appointed to hold hearings and investigate all bills before the committee to abolish or amend the public utilities act.

ONLY SMALL INCREASE IN DOMESTIC LIGHTING COST

National Industrial Conference Board Shows that Household Consumer Was Affected Slightly by Advances in Rates for Electricity

Reviewing "War-Time Changes in the Cost of Living," the National Industrial Conference Board says in Research Report No. 14, dated February, 1919:

The average increase up to November, 1918, in rates charged for gas and electricity for domestic use was small. Few if any changes were made within the war period prior to 1917. The National Electric Light Association reported in June, 1918, that of 173 cities having a population of 40,000 or over there had been rate increases in 96 in the sixteen-month period ending May 1, 1918. Many petitions for further advances were pending before public utilities commissions. These increases for the most part were in rates charged for power, however, and affected the domestic consumer but little. A study of eighty-two cities by central stations showed that in only twenty-three had the advanced rates resulted in higher cost of electricity for wage earners. The average increase in these twenty-three cities was less than 10 per cent. Contracts specifying an automatic advance in the charge for electricity with an advance in the price of coal had affected small consumers only slightly up to November.

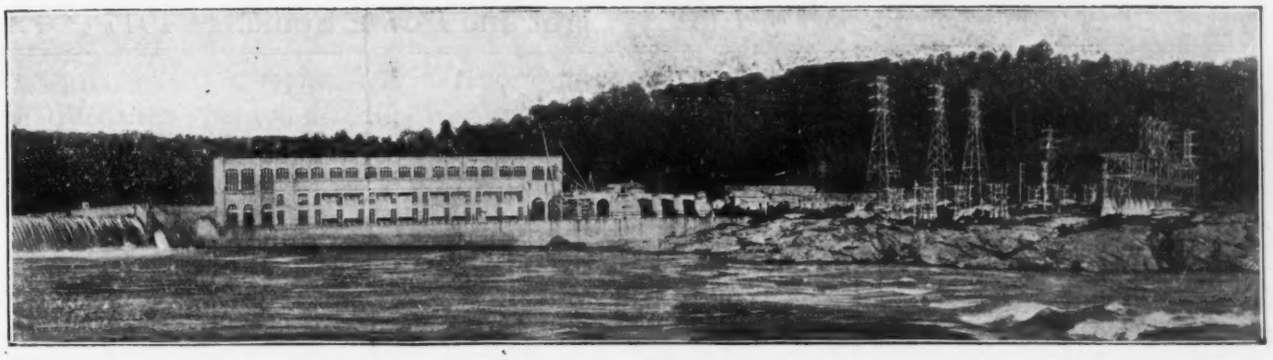
The American Gas Association reported on the 1029 companies in the United States manufacturing and supplying artificial gas. The districts served by these companies had a population of 45,000,000. Between Jan. 1, 1917, and Nov. 15, 1918, 453 companies, or 44 per cent of the total, had raised their rates to domestic consumers; the increase averaged 18.3 per cent. The average increase for the country as a whole would, of course, be less.

From these data it appears that the average advance in the cost of electricity and gas the country over between July, 1914, and November, 1918, was small. The relative importance of these items in the family budget, moreover, is less than that of fuel. In estimating the increase in the combined cost of fuel, heat and light these facts must be considered.

The increase in the cost of fuel, heat and light combined between July, 1914, and November, 1918, is placed at 55 per cent. This is a fair average, taking into account the large advances in the prices of bituminous coal, wood and oil, which are important fuels in certain sections of the country. While increases in some localities have varied considerably from the average, this is of no great importance since fuel, heat and light together require less than 6 per cent of the total family expenditure and a difference of as much as 20 per cent would cause only about 1 per cent change in the total budget.

War Record of Byllesby Utility Properties

The third edition (Jan. 1, 1919) of the "National Service Record" of H. M. Byllesby & Company and affiliated companies has been issued. It shows an increase of 256 men in the service since July 1, 1918, making a total of 951 so engaged, or 19.7 per cent of the organization's male employees. Only twenty casualties are recorded, nine deaths, ten wounded men and one man missing in action. More than $2,500,000 was subscribed by the organization and its employees to the four Liberty loans, and they gave more than $500,000 to various charities.



PENNSYLVANIA WATER & POWER COMPANY SERVICE IN WAR

Favorable Opportunity for Established Hydroelectric Developments in Present Cost Conditions—Useful Work in War Exigency

Reporting on the operations of the Pennsylvania Water & Power Company for the fiscal year 1918, President Charles E. F. Clarke illustrates the favorable position of established hydroelectric developments under present high-cost conditions.

"Your company, in common with other businesses, has experienced the effect of high prices of material and labor," he says; "however, with your company these have been of minor effect, since it is the fixed capital charges which play the predominant part of the running expenses of hydroelectric development, and the investment in this particular development was incurred during the pre-war period of low prices. The increase in the cost of labor, coal and generating equipment, which particularly affects production of energy by steam, can scarcely be expected to recede to previous lower levels, and there is thus apparent a favorable opportunity to those hydraulic developments now established on a going basis for the negotiation of more favorable power contracts as the present contracts terminate. In this connection it should be understood that two of your companies' contracts expire within the next three years. The greatest element of increase in the expense of conducting the company is, naturally, that of federal taxes, which now constitute a large factor in that expense."

Mr. Clarke said that the load requirements of the company's customers, particularly that of the Consolidated Gas, Electric Light & Power Company of Baltimore, have shown such a favorable increase that now less than 60 per cent of the total load requirements of the customers is being supplied from the hydroelectric development, the rest having to be generated by steam. The market for hydraulic power in the district covered by the transmission lines thus considerably exceeds the supply available. In speaking of the service of the company in war work Mr. Clarke said:

"During the year the furnace plant of the Shawinigan Electro Products Company (owned by your company) contributed a considerable amount of ferrosilicon to the supply required by this country for war work. The unusual quantities of steel being manufactured made this product especially in demand, and the furnace plant was taxed to produce its utmost output. Nevertheless, at one period the requirements for power in the district were so acute that the furnace plant was reduced in its allotment of electrical energy, in order to devote the energy so released to certain war industries. The furnace plant layout was such as to lend itself particularly well to rendering this assistance, indicating in a new direction the special utility of this addition to the equipment of your company.

"The establishment near Baltimore in 1918 of a large government plant for handling of materials for gas warfare brought forth a demand for power—immediate and urgent. The situation was met by the Consolidated Gas, Electric Light & Power Company of Baltimore arranging to furnish this demand from its steam stations and to transmit the same over the Baltimore transmission lines of your company, while for its part your company, as a patriotic duty, lent its services to construct without profit a high-tension transmission line tapping its main Baltimore circuits, so as to carry the energy to the government arsenal at Edgewood. Your company was glad to have this opportunity of proving its added usefulness in the war situation. The availability of a large supply of hydraulic power from your development has in the situation proved of advantage to the nation and in a very direct manner of advantage to Baltimore."

Census Bureau Report of Electric Light and Power Stations—1917

	Maine			North Carolina and South Carolina			Georgia		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	93	79	....	241	155	55.5	176	126	....
Commercial	87	75	....	120	85	....	48	42	....
Municipal	6	4	....	121	70	....	128	84	....
Income †	†$3,169,388	†$2,118,508	49.6	‡$9,911,925	‡$5,958,586	66.3	¶$3,447,235	¶$1,968,599	75.1
Electric service	$2,910,645	$1,815,086	60.4	$9,482,231	$5,670,150	67.2	$3,375,221	$1,881,985	79.3
All other	$258,743	$303,422	—14.7	$429,694	$288,436	49.0	$72,014	$86,614	—16.9
Total expenses, including salaries and wages	$2,404,786	$1,577,938	52.4	$7,626,168	$3,896,878	95.7	$2,698,730	$1,655,420	63.0
Number of persons employed	772	629	22.7	1,640	1,136	44.4	915	697	31.3
Salaries and wages	$619,739	$402,394	54.0	$1,165,775	$713,534	63.4	$583,891	$417,959	39.7
Total horsepower	98,248	89,683	9.5	495,023	283,479	74.6	125,674	87,951	42.9
Steam engines:									
Number	52	58	....	191	157	21.7	174	156	11.5
Horsepower	22,478	19,610	14.6	95,274	54,438	75.0	50,055	35,274	41.9
Internal-combustion engines:									
Number	7	3	....	30	6	....	17	4	....
Horsepower	180	135	33.3	993	535	85.6	518	720	—28.1
Waterwheels:									
Number	192	175	9.7	165	140	17.9	58	45	....
Horsepower	75,590	69,938	8.1	398,756	228,506	74.5	75,101	51,957	44.5
Kilowatt capacity of dynamos	63,242	58,757	7.6	311,915	175,507	77.7	84,330	56,232	50.0
Output of stations, kilowatt-hours	165,504,379	117,092,565	41.3	872,142,636	427,324,494	104.1	184,136,059	87,571,815	110.3
Stationary motors served:									
Number	3,890	2,258	72.3	6,082	7,328	—17.0	4,238	1,964	115.8
Horsepower	56,985	32,535	75.1	97,013	188,215	—48.5	81,517	50,633	61.0
Number of street lamps:									
Arc	322	1,411	—77.2	2,893	4,083	—29.1	480	2,370	—79.7
Incandescent, etc	17,918	9,839	82.1	21,441	8,407	155.0	14,590	7,283	100.3

* A minus sign (—) denotes decrease; percentages omitted where base is less than 100.
† Exclusive of $1,068,302 in 1917 and $789,166 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $2,500,345 in 1917 and $1,206,248 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $4,880,551 in 1917 and $2,305,083 in 1912, reported by street and electric railway companies as income from sale of electric energy.

	Illinois			Washington			Iowa		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912†	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	303	269	12.6	88	70	....	325	223	45.7
Commercial	182	170	7.0	74	60	....	181	159	13.8
Municipal	121	99	22.2	14	10	....	144	64	....
Income	$46,245,976	$30,045,297	53.9	‡$4,295,845	‡$3,087,721	39.1	¶$10,240,235	¶$4,405,365	132.4
Electric service	$45,402,293	$27,376,119	65.8	$4,201,216	$2,976,297	41.2	$9,785,509	$4,078,167	139.9
All other	$843,683	$2,669,178	—68.4	$94,629	$111,424	—15.1	$454,726	$327,198	39.0
Total expenses, including salaries and wages	$37,921,833	$23,557,887	61.0	$3,433,747	$2,270,132	51.3	$8,669,600	$3,328,740	160.4
Number of persons employed	9,294	8,036	15.7	1,112	1,078	3.2	2,083	1,329	56.7
Salaries and wages	$8,636,523	$6,223,882	38.8	$1,093,365	$880,309	24.2	$1,679,790	$921,096	82.4
Total horsepower	1,046,386	645,631	62.1	151,038	95,884	57.5	263,804	77,131	242.0
Steam engines:									
Number	503	576	—12.7	46	55	....	265	308	—14.0
Horsepower	982,740	605,227	62.4	36,270	18,128	100.1	90,675	67,444	34.4
Internal-combustion engines:									
Number	119	35	....	16	3	....	158	52	....
Horsepower	4,661	3,042	53.2	600	165	263.6	7,251	2,658	172.8
Waterwheels:									
Number	90	92	....	70	64	....	92	58	....
Horsepower	58,985	37,362	57.9	114,168	77,591	47.1	165,878	7,029	2259.9
Kilowatt capacity of dynamos	737,621	477,917	54.3	99,875	57,283	74.4	184,506	53,237	246.6
Output of stations, kilowatt-hours	2,210,372,750	1,150,900,306	92.1	242,370,956	71,414,473	239.4	614,808,584	67,166,647	815.3
Stationary motors served:									
Number	20,559	46,278	—55.6	5,678	2,279	149.1	13,039	8,773	48.6
Horsepower	1,079,652	315,659	242.0	64,694	28,148	129.8	89,902	43,820	105.2
Number of street lamps:									
Arc	15,002	35,399	—57.6	1,047	2,661	—60.7	2,479	3,637	—31.8
Incandescent, etc	132,380	41,065	222.4	26,594	20,223	31.5	49,652	27,479	80.7

* A minus sign (—) denotes decrease. Percentages are omitted where base is less than 100.
† Many of the companies operate both light and power stations and electric railways, and their systems of bookkeeping will not always permit the preparation of separate reports. For this reason, a number of establishments reported as in the light and power station industry in 1907 were treated as belonging to the electric railway industry in 1912; but some of these establishments were restored to the light and power industry for 1917. In every case the establishment was assigned to that industry to which the greater part of its operations pertained.
‡ Exclusive of $5,556,757 in 1917 and $4,422,080 in 1912, reported by street and electric railway companies as income from the sale of electric energy.
¶ Exclusive of $2,487,981 in 1917 and $1,144,220 in 1912, reported by street and electric railway companies as income from the sale of electric energy.

	Montana			Arkansas			Indiana		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	60	29	....	96	74	....	237	201	17.9
Commercial	54	27	....	71	56	....	147	130	13.1
Municipal	6	2	....	25	18	....	90	71	....
Income	†$9,695,196	†$3,883,410	149.7	¶$1,801,889	¶$1,053,763	71.0	$12,976,059	$7,711,223	68.3
Electric service	$7,947,011	$3,292,385	141.4	$1,737,999	$1,016,664	71.0	$12,114,801	$7,417,484	63.3
All other	$1,748,185	$591,025	195.8	$63,890	$37,099	72.2	$861,258	$293,739	193.2
Total expenses, including salaries and wages	$5,474,003	$2,411,668	127.0	$1,450,358	$749,029	93.6	$11,009,764	$6,028,909	82.6
Number of persons employed	732	514	42.4	459	360	27.5	2,897	2,269	27.7
Salaries and wages	$969,498	$625,918	54.9	$338,417	$242,267	39.7	$2,371,606	$1,525,875	55.4
Total horsepower	345,004	115,710	198.2	36,599	25,860	41.5	301,150	185,503	62.3
Steam engines:									
Number	39	38	....	130	115	13.0	351	352	—0.3
Horsepower	8,684	12,750	—31.9	31,498	22,599	39.4	270,219	159,888	69.0
Internal-combustion engines:									
Number	39	1	....	44	5	....	46	17	....
Horsepower	1,403	75	....	2,561	221	1058.8	3,268	1,700	92.2
Waterwheels:									
Number	82	64	....	10	10	....	90	90	....
Horsepower	334,917	102,885	225.5	2,540	3,040	—16.4	27,663	23,915	15.7
Kilowatt capacity of dynamos	182,079	74,398	144.7	24,913	16,335	52.5	227,825	135,801	67.8
Output of stations, kilowatt-hours	965,453,777	379,212,617	154.6	38,644,801	17,786,660	117.3	441,063,385	236,944,000	86.1
Stationary motors served:‡									
Number	7,374	1,962	275.8	1,112	994	11.9	14,268	14,005	1.9
Horsepower	306,241	75,184	307.3	11,533	5,283	118.3	139,724	91,897	52.0
Number of street lamps:									
Arc	1,966	1,560	26.0	1,138	1,045	8.9	11,610	14,989	—22.5
Incandescent, etc	10,664	2,791	282.1	9,302	4,731	96.6	46,109	19,873	132.0

* A minus sign (—) denotes decrease. Per cent not given where base is less than 100.
† Exclusive of $319,671 in 1917 and $242,305 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ The number of the motors for which the total horsepower is given was not fully reported.
¶ Exclusive of $653,592 in 1917 and $612,953 in 1912, reported by street and electric railway companies as income from sale of electric energy.
§ Exclusive of $2,453,624 in 1917, and $1,144,774 in 1912, reported by street and electric railway companies as income from sale of electric energy.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Conference Club of New York.—A meeting of the Conference Club of New York, which consists of the larger electrical contractors, will be held at White Sulphur Springs, Va., from May 1 to May 3.

Jovian Electric League, Kansas City.—The Kansas City Light & Power Company was the host to Jovians, city officials and newspaper men at the Feb. 21 meeting of the Jovian Electric League of Kansas City. F. S. Dewey, assistant general manager, explained slides showing the progress of construction of the new plant.

St. Louis Electrical Board of Trade.—On March 4 the St. Louis Electrical Board of Trade was addressed by W. A. Layman, president of the Wagner Electric Manufacturing Company, on "Future Possibilities of the Electrical Industry," particular attention being paid to the subject as it applied to St. Louis and surrounding territory.

N. E. L. A., Philadelphia Electric Company Section.—This section of the National Electric Light Association announces the following activities: B. Frank Day spoke before the Meter Branch Section March 11 on "The Paymaster's Office"; F. H. Brick was the speaker at the Engineering Section March 18, his subject being "The Controller's Department." C. J. Russell will address the Commercial Branch Section March 25 on the progress made by the Philadelphia Electric Company during 1918.

Association of Iron and Steel Electrical Engineers.—Electric brass furnaces have replaced fuel-fired crucibles for melting brass in a number of mills because of the great reduction in spelter loss from brass melted in the electric furnace. Metallurgical efficiency is of prime importance in an electric brass furnace, and some have failed because, in their design, electrical and thermal characteristics were considered to the exclusion of the practical problems of the brass melter. These points were brought out by W. H. Clark, works manager of the Bridgeport (Conn.) Brass Company, when he told of his successful experience with induction-type brass furnaces in an illustrated paper entitled "Applications of Electricity to the Brass Industry," presented at the March 15 meeting of the association at Pittsburgh, Pa. M. H. Bennett, Louis Sadler, E. Friedlander, Sol. Levine and W. E. Moore contributed to the discussion, which centered around the use of electric furnaces in the brass industry.

Synchronous Club, Los Angeles.—The subject of oxy-acetylene welding was taken up by Le Roy Andrews at a meeting the Synchronous Club of Los Angeles held on March 11.

N. E. L. A., Portland Section.—Dr. W. C. Morgan, head of the department of chemistry, Reed College, Portland, Ore., spoke on "Chemistry of the War" before a recent joint meeting of the Portland Sections of the National Electric Light Association and the American Institute of Electrical Engineers.

Boston "Get-Together" Luncheons Are Resumed.—On Feb. 28 New England electrical men began again their "get-together" luncheons in Boston. Dr. R. L. Jones, transmission engineer of the Western Electric Company, gave a talk on "Voices from the Sky, or the Inside History of the Development of Wireless Telephony for Airplanes During the War." Four luncheons are planned for the spring months under the general auspices of the New England Section, National Electric Light Association.

American Association of Engineers.—The New York Chapter of the American Association of Engineers will hold a meeting on the evening of March 28 at the Hotel McAlpin, New York City. C. E. Drayer, national secretary of the association, will speak on the "Aims and Accomplishments of the American Association of Engineers." On March 13 John Ericson, city engineer of Chicago, addressed the engineers in Madison, Wis., on "The Engineer in Public Service." These officers have been elected by the Philadelphia Chapter: President, F. P. Roth, Belmont Iron Works of Philadelphia; recording secretary, M. F. Frick, Emergency Fleet Corporation; corresponding secretary, H. F. Kuzel, David Lupton Sons Company.

American Institute of Electrical Engineers

Fort Wayne Section.—An address by E. A. Barnes on "The Industrial Derelict" was given on Feb. 20.

Denver Section.—W. H. Bullock of the Westinghouse Electric & Manufacturing Company had for his subject "Building Lighting" at the meeting held on March 15.

San Francisco Section.—"The Unification of Manual and Automatic Telephone Systems at Los Angeles" was the subject of B. C. Wiseman's talk before the Feb. 7 meeting.

Detroit-Ann Arbor Section.—"Modern Applications of the Electron Theory" was the title of an address given by Dr. Saul Dushman, research laboratory, General Electric Company, at the March 21 meeting.

Fort Wayne Section.—"An Engineering Discussion of Fractional-Horsepower Motors" will be the subject for the April 17 meeting. It will be discussed by engineers of the Fort Wayne Works, General Electric Company.

Pittsfield Section.—"A Trip to California" was the title of a lecture, illustrated by many lantern slides and feet of moving pictures, given before this section on Feb. 27 by John P. Clum, Bureau of Service, United States Railroad Administration.

Spokane Section.—Dr. C. E. Magnusson, professor of electrical engineering, University of Washington, had for his subject "A Plan for the Development of Our National Electric Power Resources" at a joint meeting of the Spokane Engineering and Technical Association and the Spokane Sections of the American Society of Civil Engineers, the American Institute of Mining Engineers and the A. I. E. E.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Contract Rates.—In a recent decision approving an increase in rates by the Lincoln Water Company the Maine Public Utilities Commission presents an unusually exhaustive discussion of the regulatory powers of the state over public utility contract rates. Extracts from the decision follow: "It may be suggested that the company ought to be held to its bargain whatever the hardship. This is neither expedient nor altogether just. The company cannot continue indefinitely to render service at a loss. It cannot discontinue the service at its pleasure, nor is it desirable that it should. The town has been placed at no disadvantage by reason of the contract. The only loss suffered is that suffered by the company. The town has gone to no expense by reason of it. The only thing it has parted with is the franchise, and this is a liability under the present rates, not an asset. . . . The most that can be said in behalf of remonstrants' contention in respect to the attempted regulation of the domestic rates is that the state had not then entered that field; that the municipality, with the consent of the company, assumed jurisdiction, and that its right to do so had not been questioned until the present time. That certainly is not a delegation by the state of its police power in the manner required to make it irrevocable. It amounts at most only to a sort of tacit recognition by the state of the city's right to contract for rates, subject, however, to the paramount authority of the state whenever it chooses to exercise its sovereign power of rate regulation. . . . Unquestionably, we think, the domestic rates are not affected by any lawful contract, and are subject to the jurisdiction of this commission just as though they had not been mentioned in the agreement invoked in this case."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

United States Department of Public Works.—The Association of Engineers, acting through the committee on engineering coöperation, of which F. H. Newell of Urbana, Ill., is chairman, is endeavoring to promote sentiment in favor of a United States Department of Public Works. In the interest of its work the committee has written a letter on the subject to all engineering societies in the United States.

Public Utility Digest of Indiana.—The "Public Utility Digest," published by the Publication Service Company, Indianapolis, is being issued to review and digest temporary surcharge and rate rulings and all other matters of interest which come before the Public Service Commission of Indiana, federal bodies and various courts. It gives a summary of all Indiana public utility cases. Will B. Smith is president and A. S. Blakeley vice-president of the company. Alex. R. Holliday is treasurer and head of an advisory committee, composed of representatives of the various state utility associations.

Ice Business of Commonwealth Edison Company.—During the year 1918 the Commonwealth Edison Company took on seven new ice plants, making a total of thirty-two plants which are now operating over the company's lines. In these plants during 1918 there were produced 643,000 tons of ice and 1,543,000 gal. of ice cream. The ice and refrigeration plants connected to the company's lines used 33,000,000 kw.-hr. of electricity. Sixty-five per cent of all the artificial ice manufactured in the city is made by central-station electric service, and 28.5 per cent of all the ice used, including both natural and manufactured ice, is manufactured by central-station service.

Methods of Classifying Army Personnel.—Employers and others interested in personnel work will have an opportunity to examine the methods developed by the committee on classification of personnel in the army at an exhibit to be shown on the third floor of the Engineering Societies Building, New York City, April 1 to 12, 1919. This exhibit consists of a collection of wall charts, forms, photographs and models showing how the army finds out what men can do best and how it uses that information, how soldiers are trade-tested, and how officers are rated and fitted into place; how the work is checked and supervised, and its results in the war. The collection is being shown under the auspices of the National Association of Corporation Schools and the United Engineering Society, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. It was on exhibition for several weeks at Washington, where it excited so much interest that in response to many requests the Adjutant General consented to its display in other cities. Two commissioned officers accompany the exhibit to explain its various features.

Rates for Keokuk Energy.—The Missouri Senate committee on private corporations has reported favorably a bill intended to settle a question as to the power of the Missouri Public Service Commission over the rates charged the United Railways Company of St. Louis and the Union Electric Light & Power Company, St. Louis, for electrical energy generated at Keokuk. While members of the commission believe that it now has that power, there has been some uncertainty because the energy comes from another state. Senator Gardner has said that he is confident that if the bill should become a law the commission could set aside any unjust or unfair contracts which St. Louis public utilities might have made for Keokuk electricity.

"Public Service Rates Based on Cost."—Charles H. B. Chapin, secretary Empire State Gas & Electric Association, discusses this new plan for determining fair rates in a recent issue of *State Service*. He says that the method of procedure which apparently meets with the greatest favor consists of the company and the municipality or municipalities served entering into a contract, the enforcement of which is left largely in the hands of the state commission. Among the specific provisions which Mr. Chapin says such a contract should include are these: "A bonus to be payable to the company in consideration of increased efficiency in operation. . . . The public would agree to assume responsibility for the entire cost of the service, including cost of capital as well as cost of labor and of materials. Provision would be made for a conference early in each year between the representatives of the municipalities, the commission and the company, at which the financial situation would be gone over and the budget of cost of service for the ensuing year decided upon. The company itself should be given considerable latitude in arranging its rate schedule, as this involves both technical skill and experience, in order that the efficiency of operation be not impaired with consequent increase in cost. The contract should contain some provision under which other conferences could be called as conditions might make them necessary. For example, the public as a partner is interested in the question of wages, . . . or an expensive extension might be desired which would not be immediately self-supporting."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Municipal Regulation of Rates Provided by Contract.—Where an ordinance is passed by a municipal corporation granting to a gas company the right for the term of twenty-five years to furnish natural gas for heating, lighting and power purposes, through its mains and appliances in the streets and public places, on terms and conditions contained in the ordinance, which include a provision that the grant is subject to the right of the city to regulate the price of natural gas from time to time as provided by law, the acceptance of the ordinance by the company constitutes a valid contract, and the rights of the parties are to be determined by the contract itself, according to the Supreme Court of Ohio (121 N.E. 688). In such case the grant to the company is subject to and dependent on the right reserved to the city to fix the price of gas from time to time as provided by law. Statutes in force at the time a contract is made by a municipality enter into and become part of the contract. Its obligation is to be measured and performance is to be regulated by the rules which they prescribe.

Rights of City Over Poles and Wires in Streets.—An ordinance prohibiting erection or repair of poles and wires in streets and alleys is prima facie within the city's power, according to the Supreme Court of Illinois (121 N.E. 565). Where a city enacts an ordinance licensing a public service company to maintain poles and wires in its streets for the necessary and reasonable conduct of its business, the ordinance, when accepted and acted upon, becomes a contract which the city cannot arbitrarily abrogate. The mere fact that ordinance prohibiting erection and repair of wires and poles in streets and alleys could not be enforced against company holding franchise so to use the streets and alleys would not invalidate ordinance as to others. Where ordinance prohibited erection and repair of wires and poles in streets and alleys court could not presume, from the fact that a company had wires and poles in streets, that it had a franchise to keep them there, however unusual such use without a franchise. In prosecution for violating ordinance prohibiting wires and poles in streets and alleys, defendant had burden of showing that his employer had a franchise so to use the streets, if that were the fact. In prosecution for violating ordinance prohibiting wires and poles in streets and alleys, defendant could not make the point that no employees of any other telephone company had been arrested.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

F. A. Noyes is now acting as superintendent of the southern as well as the eastern district of the Consumers' Power Company, Jackson, Mich.

Harry Hart, for the past twenty years with the Commonwealth Edison Company, has joined the electrical staff of the Coyne Trade and Engineering Schools, Chicago.

Col. H. M. Byllesby, president of H. M. Byllesby & Company, has been elected president of the Chicago branch of the National Security League, succeeding H. H. Merrick.

Lorne C. Webster has been elected president of the Quebec Railway, Light, Heat & Power Company to succeed Sir Randolphe Forget, deceased. Mr. Webster was vice-president of the company.

E. A. Luney has been appointed divisional assistant superintendent of the Public Service Company at Morris, Ill., to succeed H. H. McCullom, resigned. Mr. Luney recently returned to the employ of the Public Service Company from the army, where he obtained the rank of captain.

E. W. Doty, who was formerly a member of the Public Utilities Commission of Ohio, has opened an office as public utility consultant, to undertake work involving service-at-cost franchises, rate investigations, appraisals and land valuations, at 16 South Third Street, Columbus, Ohio.

F. K. Woodring has been elected a director of the Northwestern Ohio Railway & Power Company, Toledo, Ohio, to succeed George H. Tuttle; vice-president of the company, to succeed J. B. Taylor, resigned, and general manager of the company, to succeed E. A. Burrill, resigned.

B. C. Edgar has succeeded F. W. Hoover, vice-president, in active charge of the affairs of the Tennessee Power Company and the Chattanooga Railway & Light Company. Mr. Hoover retains his position as vice-president and remains as a member of the board of directors. Mr. Edgar will retain the position which he has held previously as general superintendent of the Nashville Railway & Light Company. Prior to going to Nashville he was assistant general superintendent of the Columbus (Ohio) Railway, Power & Light Company.

Fred V. Underwood has reëntered the service of the Birmingham (Ala.) Railway, Light & Power Company as assistant general manager. Mr. Underwood was with the company in various positions for many years. He was troubleman, installation man, meter reader, meter tester and inspector in charge of the meter and arc-lamp department. He was promoted to the position of chief engineer at the power house and later became assistant superintendent of the electric department and finally superintendent of the electric department and electrical engineer for the company. Last October Mr. Underwood resigned to become superintendent of production for the Alabama Power Company.

Herman Russell, assistant manager of the Rochester (N. Y.) Railway & Light Company, has been appointed general manager to succeed James T. Hutchings, recently elected president of the company.

Frank Glosser has resigned as manager of the lighting department of the Columbus, Delaware & Marion (Ohio) Railway Company to become general manager of the Commercial Steel Castings Company, Marion.

S. A. Redding has resigned his position as general superintendent of the electrical department of the Georgia Railway & Power Company, Atlanta, to return to the Republic of Brazil, where he previously resided from 1897 to 1903.

Calvert Townley, assistant to the president of the Westinghouse Electric & Manufacturing Company, has been reappointed by the Engineering Council chairman of the water conservation committee. He was also reappointed a member of the reconstruction committee.

L. C. Stacy has succeeded Frank Glosser as manager of the lighting department of the Columbus, Delaware & Marion (Ohio) Railway Company. Mr. Stacy has been an electrical engineer in the chemical warfare division of the army. Prior to going into the service he was an electrical engineer with Sargent & Lund, consulting engineers, Chicago.

Thomas F. Johnson, who has been assistant superintendent of the electrical department of the Georgia Railway & Power Company, Atlanta, Ga., has been appointed to succeed S. A. Redding, resigned, as general electrical superintendent of the company. Mr. Johnson before becoming assistant superintendent of the electrical department last summer was superintendent of transmission and distribution. He is particularly well known in the field for his work on live lines.

W. H. Sawyer, vice-president of the E. W. Clark & Company Management Corporation, has been elected president of the East St. Louis Suburban Railway Company, East St. Louis Railway and Alton, Granite & St. Louis Traction Company and vice-president of the St. Louis & Belleville Electric Railway, Alton Gas & Electric Company and St. Louis & East St. Louis Electric Railway. Mr. Sawyer has been associated with the E. W. Clark Company and interests since the summer of 1914. Prior to that he was engineer in charge of the New York office of Ford, Bacon & Davis, consulting engineers, New York City. Mr. Sawyer was born forty-five years ago at Schoolcraft, Mich. In 1894 he was graduated from the University of Nebraska and for two years was with several street railway companies. He then entered the employ of the General Electric Company in the railway and engineering departments, where he continued for nine years. The next nine years he spent with Ford, Bacon & Davis.

Obituary

Charles Hall, manager of the William Hall Electric Company, electric supply jobbing, Dayton, Ohio, died on Feb. 22, following an operation.

Edward Soukup, commercial engineer for the Iowa Railway & Light Company, Cedar Rapids, Iowa, died on Feb. 23 at the age of thirty-two years. Mr. Soukup upon graduation from the Iowa State College in 1907 entered the employ of the General Electric Company. Two years later he joined the commercial department of the Iowa Railway & Light Company, where he remained until his death.

J. O. Hardin, electrical engineer in the Southeast for Lockwood, Greene & Company of Boston, died in Atlanta, Ga., on Feb. 28, of peritonitis, following a sudden attack of appendicitis. Mr. Hardin before being associated with the Boston firm was engineer of the electrical department of the Georgia Railway & Power Company, Atlanta, with which company he had been associated since 1912. Prior to that he had been employed by the General Electric Company.

Philip S. Dyer, who was an associate of Thomas A. Edison for thirteen years, died March 10 at his home in New York City in his sixty-third year. Mr. Dyer left the lumber business in 1879 to work in the Edison laboratories. For ten years he was European representative of the Edison Electric Company. In 1892 he returned to the United States to enter business for himself. At the time of his death he was a director of the Chamber of Commerce of the United States and a member of the Engineers' Club, besides having a number of other affiliations of a similar nature to these.

James M. Poyner, a well-known electrical engineer, for ten years connected with the Baltimore office of the General Electric Company, died at Charleston, W. Va., on March 3 at the age of thirty-seven from influenza. Mr. Poyner was born in Alabama and was a graduate of Auburn College of Alabama and a member of the Engineering Club of Baltimore and the American Institute of Electrical Engineers. He went to Baltimore from the Lynn Works of the General Electric Company and remained there until Jan. 15 last, when he resigned to take up new work in Charleston, W. Va.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

CO-OPERATIVE STOCK LIQUIDATION BY JOBBERS

Local Market Made More Stable and Profitable by Preventing Price Cutting to Move Overstock

The practice being followed in a few places in the country by electric supply jobbers with long stocks, of disposing of their surplus to competitors, is meeting with favor. There is hardly a sizable jobbing locality where some jobber is not long on one or more items. To liquidate this stock by quoting a price low enough makes the local market extremely unstable besides engendering bad feeling in the trade.

The plan followed in some places is for the other jobbers to take the overstock at current prices. This places the entire trade on a common basis and makes it possible to do more business at a profit.

As a further means of liquidating local stocks many jobbers are placing small orders with competitors rather than with the manufacturer. The manufacturers, however, are not all unfavorable to this scheme. By keeping the market stable the manufacturers reap certain benefits. Nor is the least benefit that of keeping their distributers in a strong credit position.

CURRENT VOLUME OF BUSINESS SATISFACTORY

Manufacturing Output Exceeds That Prior to War, Jobbing Sales Are Ahead of Last Year and Retail Sales "Best Ever"

Four months ago every one viewed the general business situation with alarm. Buying was expected to fall flat and prices to drop to low levels. Now it is gradually dawning upon people that this situation was merely a state of mind. To be sure, there is not the volume of purchasing going on that prevailed during the last year of the war. Moreover, some prices have dropped, principally of raw materials.

Considering the electrical trade as a whole, however, conditions are good. The output of electrical manufacturers is running on the whole probably not more than 25 per cent behind the maximum rate during 1918. While the manufacturers are not running to capacity, it is probably true that on the whole they are turning out to-day a volume of goods fully as great as they were turning out in March, 1916, and greater than at any time prior to the war.

Electrical jobbers did on the whole a business from 8 to 10 per cent larger in January and February of this year than during the first two months of 1918. Typical of this condition is a statement by a prominent Minnesota electrical jobbing house:

"Our business during January was larger than for any previous January in the history of our company, and it looks very much as if we should be able to say the same thing about February too.

"Our telephone customers are already beginning to carry out their plans for extensions that the war held up for so long. January is usually not a good pole-setting month, on account of inclement weather; still, our telephone friends placed more carload orders for poles during January than they did during any month last year, and with the poles went the usual supply of pole-line hardware, wire and telephone equipment.

"Our central-station customers are also figuring on extensions to their lines and plants. Inquiries and orders for line material, wire and wiring devices, generating equipment, transformers, meters and so forth are coming in in great shape. Evidently the central stations are fully determined to make up for lost time.

"An analysis of our dealer-contractor business also brought out similar facts. The demand for electrical home labor-saving devices is increasing right along. Washing and ironing machines, vacuum cleaners, portable sewing machines, heating devices, to mention only a few of the many electrical appliances, are being sold by our dealer-contractor customers in a way that makes us feel highly optimistic."

Retail sales are probably larger than they ever were. People have money and are spending it. High-priced electrical appliances are moving fast.

It is true that sales are not being made in the large quantities to-day that they were last year, but that is natural. In the first place, it is not logical to suppose that distributers and retailers are going to lay in large stocks the price of which may fall. They prefer to place smaller and more frequent orders. And from the wholesaler's standpoint that is good business because it minimizes the outstanding credit risk at a time when it is really essential to have outstanding credit in the position where it is most easily collected. In the second place, it is no longer necessary to order in such quantities as were placed last year because deliveries are better and goods may be had to-day very quickly.

With the spring just coming and all of the construction that goes with it, the outlook for the electrical trade is far from being dark.

ELECTRICAL MATERIAL IS COMING BACK ON MARKET

Reports Indicate Numerous Instances Where Supplies Have Been Sold at Prices Considerably Under the Current Market Price

Reports come in from scattered sources that electrical materials are coming back on the market from the government and from industrials no longer engaged in war work at prices ridiculously low.

For instance, at Camp Dodge it is reported that approximately a quarter of a million feet of No. 14 rubber-covered wire was sold at $5.50 per 1000 ft. when the jobbers' cost was around $10.50. The wire was purchased in partial lots by local contractors, and the first intimation which local jobbers had of the situation was when a contractor with whom they were doing business found that a competitor had underbid him to the extent of about $1,000. It then developed that the low bidder was using government wire.

As another instance the sale which has been made by the government aviation school at St. Paul, Minn., to the Chicago House Wrecking Company has been cited. This material has been listed by the Chicago House Wrecking Company in a mail-order catalog which is distributed among electrical dealers. Another instance is cited by a jobber from the South, who states that he had seen bills of sale for conduit in which ½-in. conduit changed hands at $3.10 per 100 ft. and in which the larger sizes sold at even cheaper prices. It is also stated that a line erected to serve Camp

Beauregard at a cost around $68,000 was offered for sale for around $3,000.

A representative of one of the larger electrical manufacturing concerns points out that a large amount of used material, particularly motors, is finding its way back on the market at low prices. The intention of the government, of course, so far as government material is concerned, is to prevent the material from coming on the market through junk channels at prices that would tend to demoralize the market. Only a couple of weeks ago the spruce division refused bids on material, among which were a number of motors, because the bids were too low.

It has been announced that the manufacturers would have an opportunity to bid on their own material in order to prevent it coming on the market at demoralizing prices. The electrical jobbers are putting into motion a plan for absorbing small electrical material as it is released by the government. The jobbers feel that otherwise it would be easy for a junk dealer to bid in a supply of conduit and later maybe some wire and to this add other electrical supplies, all at very low prices. This dealer could quickly become a jobber and by quoting low enough prices, while still making a handsome profit, would underbid all dependable electrical supply jobbers on current business.

METAL MARKET SITUATION

Meeting of Steel Leaders Expected to Help Market—Copper and Brass Products Lower

A very quiet market characterized the past week. Much interest is centered in the meetings of the leaders of the steel trade and government officers. The schedule of reduced prices, on which an agreement is expected so as to stabilize industry, was discussed by the steel trade leaders at their meeting, and it is expected that the government will follow the decision with an order for 1,600,000 tons of rails. This cut in steel is expected to be followed by similar action in other industries.

A more confident and stronger undertone was evident in the copper trade last week. Sales were about 12,000,000 lb., the most of it at from 14¾ cents to 15 cents a pound; some went at 14½ cents, and one lot for export is reported at 14⅝ cents. The larger interests still hold more firmly at 15 cents.

One favorable development is the reduction in price of finished brass and copper products, the base price of copper wire being down about 1¼ cents, the base price of copper sheets 2 cents, and the average reduction in the price of other copper-rolled products and of brass being 2½ cents a pound.

In the old-metal market the only activity appears to be for lead and type scraps and aluminum scraps.

NEW YORK METAL MARKET PRICES

	March 11	March 18
Copper:	£ s d	£ s d
London, standard spot	77 0 0	77 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	15.50	15.25 to 15.50
Electrolytic	14.87½	14.87½
Casting	14.75	14.75
Wire base	18.75 to 19.00	17.25 to 18.00
Lead, trust price	5.25	5.25
Antimony	7.00 to 7.12½	6.90
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	11.00
Spelter, spot	6.50	6.50
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent.	30.00	30.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	12.75 to 13.75	12.75 to 13.25
Brass, heavy	7.25 to 7.50	7.25 to 7.50
Brass, light	6.00 to 6.25	6.00 to 6.25
Lead, heavy	4.75 to 4.87½	4.75 to 4.87½
Zinc, old scrap	4.50 to 4.75	4.50 to 4.75

THE WEEK
IN TRADE

A CONSIDERABLE volume of business is being done in electrical lines. Orders generally are smaller, indicating caution on the part of the buyer. For January and February retail and jobbing sales on the whole exceed those of the first two months of 1918. In fact, the retail trade is probably better to-day than it ever was. As retail stocks become depleted a much better trade can be expected by the manufacturers.

Some building projects are coming to light, and more are expected during the next few weeks. As soon as the new iron and steel prices are announced a large amount of building contracts should be released.

Prices are being shaded a bit here and there, but the producers generally feel disinclined to reduce their prices just yet.

Labor shows fewer disturbing conditions this week than last. While non-employment is probably increasing, it seems probable that there is no more non-employment to-day than there is normally during the winter months.

NEW YORK

Market conditions have changed very little. Prices on many articles are shading off, but the drops are very small and there is little indication that appreciable reductions will be put in force for some time to come. Labor is still very unsettled and shows little inclination to become stabilized, and wages are showing an upward rather than a downward tendency.

By liquidating overstocks through competitors local jobbers have been able to reduce stocks on hand in a very satisfactory way. There does not seem to be such a tendency toward price cutting locally as there was prior to the war. Dry goods stores have been having sales in which the prices of electric lamps and heating devices have been badly slashed.

Regardless of the cost of building materials, many buildings would to-day be under way were it not for the hold that labor has on the building market. Contractors and real estate operators are holding off until such time as labor can be depended upon. The risk is too great for contractors to tie up their money in materials for a partly constructed building only to find a strike on their hands at a crucial point in the operation.

OUTLET BOXES.—A decrease of approximately 20 per cent is noted in outlet boxes, bushings and nuts.

RIGID CONDUIT.—Sales are greater, and the unfinished orders from one factory have been reported as increasing.

CROSS-ARMS.—Some sizes have decreased 5 to 7½ per cent on all quantities from stock.

METALLIC FLEXIBLE CONDUCTOR.—Two manufacturers have increased their discount from 33 per cent to 35 per cent.

ELECTRIC SIGNS.—The market is well under way and some very large units are coming through. Flashers are being used to a greater extent than formerly. Deliveries are about four weeks.

FANS.—Although prices, including the tax, average about 20 per cent higher, more business is expected than last year. Very vigorous campaigns are being mapped out to carry this through.

ELECTRIC TOOLS.—Considerable activity has been found in this market.

WIRE.—Rubber-covered is slightly lower this week. Of twelve manufacturers two are quoting on a 23-cent base, one on 22 cents, seven on 20 cents, one on 19 cents and one on cost.

CHICAGO

The commercial electrical field in the Middle West appears generally to have borne up very well under the conditions imposed since the first of the year. Sales have totaled more than most of the jobbers expected them to do. In fact, twenty-six jobbers in Ohio report that their total sales for the first two months of 1919 were ahead of the first two months for 1918. A similar situation is said to prevail among the important jobbers in the Chicago district. This statement, however, should not be viewed too optimistically in view of the fact that January and February of 1918 were probably the worst months of that year.

There is considerable optimism as to the prospects for central-station business. Conditions indicate that this business will not be in the nature of a few large jobs but will consist of a multitude of small extensions, additions and betterments. This makes an ideal kind of a market for the jobber. That there will, however, be some large construction work undertaken is apparent from the fact that the best estimates show about 1500 small elevators and 75 large grain elevators now projected or under way. The small elevators may take from 25 hp. to 100 hp. apiece, while each of the large elevators will take several thousand horsepower each.

Nearly all electric supply jobbers are beginning to appreciate the immense volume of business in heating appliances and small motor-driven devices which may be secured by soliciting the accounts of farm-lighting plant agents.

No sales of electrical goods by the government to consumers have been noted in the immediate district around Chicago, according to jobbers who have been endeavoring to watch the situation.

POLE-LINE HARDWARE.—Steel pins, brackets, braces and all other items of hardware included in this group have been reduced 10 per cent in price.

STEEL OUTLET BOXES.—These have been reduced in price slightly.

CROSS-ARMS.—The price of cross-arms has been reduced about 5 per cent, largely on account of changes in freight conditions. Some of the change is also attributed to the fact that the demand for airplane spruce has fallen off.

COPPER WIRE.—Both rubber-covered and weatherproof copper wire is selling at 20 cents. There are apparently plenty of inquiries, but most of these seem to be merely feelers. All of the prospective customers appear to be holding off in spite of the fact that they know they must purchase wire in order to fill the requirements of the many small jobs which central stations will have to do to meet the demands of customers that have been held off by commission rulings, etc., during the war period.

MOTORS.—The Emerson motor price book No. 46, issued on Feb. 5, 1919, shows prices approximately 10 per cent lower than those in effect from Oct. 5, 1918, to Feb. 4, 1919. The Emerson company states that the new prices have been based on manufacturing economies and efficiency.

SMALL MOTORS.—The small-motor delivery situation in some factories is still far from perfect. Manufacturers of small motor-driven devices who have been endeavoring to get shipments of small motors in weekly lots of 100 and 200 are still having their requirements scaled down to one-quarter of this amount.

CONTROL APPARATUS.—Business is reported to be dull in this line.

VACUUM CLEANERS.—One electric vacuum sweeper company has received an order amounting to $120,000 from a single central-station company.

ELECTRIC CHURNS.—Motor-driven electric churns for operation on 32-volt direct-current farm-lighting systems are enjoying excellent activity. Distributers in the southern part of the United States are ordering these from Middle Western manufacturers in car-load lots.

ELECTRIC RANGES.—The season for electric cooking equipment is opening up this year earlier than usual. The demand is expected to be more brisk than last year or the year before. Several of the larger cities which dropped the electric range business during the war period are coming back into the field and the number of small central stations which will take up the active work of selling ranges again apparently will be large.

FARM-LIGHTING PLANTS.—The price of Delco farm-lighting plants will not be changed during the year of 1919 from the figure existing at present, which is $495 for the larger model.

ELECTRIC FLATIRONS.—Manufacturers making electric flatirons for 32-volt farm-plant service are all changing their designs somewhat to prevent the cord being disconnected from the iron at the base of the iron. It is thought that bolting the plug to the handle of the iron will eliminate some trouble from burning of contacts.

BOSTON

Business holds up fairly well in electrical lines. A leading jobber reports that his February trade considerably exceeded that of a year ago and that diversified orders are coming in at a good rate. Improved business is beginning to be seen in electrical contracting circles. Nothing like a building boom has opened as yet, but considerable public building work is in sight, notably in the schoolhouse field. The Worcester Pressed Steel Company is planning to build a 90-ft. by 150-ft. rolling mill near Barbers Crossing; the Aberthaw Construction Company, Boston, has received a contract to design and construct a hundred-thousand-dollar storehouse and office at Rochester, N. Y., and construction work has begun on a new wire factory for C. O. Johnson & Sons, Jamesville, Mass. Keen interest in electrical accessories for automobiles is being displayed this week at the Boston show, storage batteries being featured.

Jobbers' stocks are beginning to run considerably lower. Ordering still reflects a hand-to-mouth policy, which the open winter and greatly improved deliveries encourage. Collections are fair, although some troublesome delays in government payments are being experienced. Central-station advertising is opening up, but the lid is still tightly clamped as to extensions in some large companies. One of these reports a total loss of about 13 per cent in load due to curtailment of war work, and it is expected that this loss will be regained in the comparatively near future. Some meritorious interconnection plans are held up at present by right-of-way difficulties, but as soon as these are cleared away construction will go forward.

WASHING MACHINES.—These outfits are selling finely, and orders are being placed on a very optimistic basis. Some large individual sales are being carried through. So far the supply of washers holds up well, and deliveries are good. Little price movement is reported.

MOTORS.—The market reflects a waiting attitude, with improving stocks in standard types and sizes. Distributers are maintaining firm prices, barring occasional slight recessions to close deals, especially in work where competition is keen.

LAMPS.—These are in good supply, and a fair trade is being handled for residential service.

SEWING-MACHINE MOTORS.—Trade is quite brisk, and the appearance of competitive makes in the New England market is stimulating inquiries.

VACUUM CLEANERS.—Stocks are now plentiful. The prospects of a good spring business are favorable, but by and large the trade in cleaners has not developed as yet to the expected magnitude.

INDUSTRIAL ELECTRIC TRUCKS. — Inquiries are coming in at a fair rate, but sales are somewhat below previous levels. Deliveries are good. New price sheets reflecting the recent reduction in alkaline batteries have not yet reached all distributers.

WIRING MATERIAL.—The demand is relatively small and manufacturers are in shape to make exceedingly prompt deliveries. Fair stocks are being carried by the jobbing houses, but little new business is coming through at the moment. This year there is little slack to be taken up between the factory and the jobber's storehouse; in other words, orders are now being placed much nearer delivery dates than in 1918.

ATLANTA

The strike of the railway clerks this week, covering most of the railroads entering Atlanta and other Southern cities, has tied up shipments, as the railroads are not receiving any freight. Industry, except in a few lines, and these chiefly textile, shows a slightly better pace and many readjustments appear to have been satisfactorily completed. Perhaps the most notable advance visible is the swelling of the building trades into a modified form of preparatory activity. Collections have slightly improved, and it is expected that this condition will be maintained, at least until the Victory loan is floated.

The increasing number of men being discharged from the various Southeastern cantonments has tended to increase non-employment. Certain industries still report a shortage of labor, however, and it is hoped that a large portion of the idle labor will soon be absorbed.

The bond for a municipal electric plant at Atlanta did not pass, as was originally reported, and it is expected that another election will be held in April. The War Department has definitely decided to go ahead with construction at Camp Benning, Columbus, Ga., on a slightly reduced scale. Souther Field, Americus, Ga., has been selected as a permanent camp for aviation. It is reported that the Mobile Electric Company, Mobile, Ala., contemplates spending $1,000,000 on a new electric plant.

MOTORS.—Manufacturers report a slight improvement in the demand this week covering capacities up to 150 hp. There has been no change in price. Factory promises of shipment have greatly improved, and all current requirements can be taken care of in a reasonable time.

TRANSFORMERS.—On the whole, the volume of transactions appears to be well sustained, with an increased demand in a few of the smaller capacities. Prices are holding up remarkably well, and stock conditions of the distributing 2300-volt type are improving weekly.

METERS.—The call continues quite steady, and the buying element does not seem to pay much attention to rumors of substantial cuts in prices. Local stocks are not up to quantities recorded last week. Labor trouble affecting incoming shipments is in a measure responsible for the decrease for this week.

PANELBOARDS.—Movement is only moderate. Shipments are much better. Prices remain firm and the local demand shows no change.

CONDUIT FITTINGS.—A slight increase in movement has been noted for this week, following a weakening in market prices. Stocks are ample.

STAMPED STEEL BOXES.—There was very little response in the way of increased demand when a decrease of approximately 8 per cent in price was recorded. Stocks are about normal.

WIRE.—The volume of sales for both rubber-covered and weatherproof is very satisfactory, and little change is to be recorded over last week. Rubber-covered and lamp-cord base is around 20 cents. Weatherproof is still clinging to an 18-cent base.

CONDUIT.—Compared with the last few weeks activity has ceased. Indications are that requirements will be much greater shortly, but the big buyers are still holding off, anticipating further reductions in steel.

SEATTLE—PORTLAND

As a result of the ruling made by the industrial division of the United States Shipping Board in Tacoma on March 15 controversies over the reinstatement of shipyard strikers have been amicably adjusted. Plants are rapidly resuming normal working conditions, and it is believed that the end of the week will find them operating at full blast.

Seattle jobbers report that sales are slightly in excess of those reported last week owing to the reopening of shipyards and industrial plants. The volume of sales to these plants is expected to increase rapidly. The lumber situation is showing a slight improvement, with prospects bright for spring work. The industry has heavy orders for spring delivery. It is predicted that a large number of plants which have been engaged in government work exclusively will reopen for general business. A number of inquiries for motor equipment are expected to develop into orders. It is believed that considerable business from small towns will be placed for extensions to plants, etc. It is generally known that numerous small projects that have been held up by the war are now being revived. Report says that the farmers of the Northwest will have the largest acreage in grain ever known. Employment conditions in eastern Washington are excellent. Indications point to an early opening of Yukon and northern Alaska trade. The State Board of Control, Olympia, announces that work on new buildings at thirteen state institutions, to cost approximately $750,000, will be started shortly. Yakima, Wash., reports plans formulated for an expenditure of $500,000 on buildings this spring.

The Portland district reports the industrial situation practically unchanged during the past week. Sales are small but consistent. Non-employment is increasing rapidly and wages remain practically the same as before the signing of the armistice.

Many commodities are gradually increasing in price. Virtually all lines of building material are unchanged. This has a deterrent effect on new construction. However, there has been an appreciable increase in the number of residence permits during the past week. Retail electrical sales show no change over last week, the volume keeping up to normal. It is predicted that the coming spring weather will bring a heavy buying of household equipment fixtures and wiring devices.

SAN FRANCISCO

Building continues rather light with no especially heavy jobs reported. The February, 1919, building permits reported were as follows: San Francisco, 281, value $650,044; Oakland, 252, value $492,598; Los Angeles, 400, value $1,008,195. From all indications 1919 will be a wonderful electrical appliance year, especially in big household appliances. At present the effort is rather feverish than methodical, and there is no doubt that the careless merchandising methods of a few dealers will have to be smoothed over later. One cannot help noticing the marked change in appearance of dealers' stores, the number of big devices on sale, the noticeable public interest in such devices and the newspaper and other forms of advertising that are seen on every hand.

WASHING MACHINES.—Sales are large, and to the list of those paying attention to this line must be added department stores. The demand seems to be very evenly divided between cheap machines of a dolly pattern and machines which sell for perhaps a third more, the average price locally being from $100 to $130 for the average family size. Deliveries are much better than last year.

SEWING MACHINES.—There are now nearly as many makes of electric portable sewing machines either on the market or shortly to be brought out as there are washing machines.

VACUUM CLEANERS.—Here at least is one device where the public almost unanimously demands quality at the expense of cheapness, for in the past year a fair demand for exceedingly cheap machines that sold below $30 has almost entirely disappeared, and certain makes or certain qualities regardless of their first cost are demanded. When this demand is analyzed it is found that it is almost entirely for a machine with a motor-driven brush. Deliveries are very poor from the factory and orders are usually snapped up long before their arrival.

HEATING DEVICES.—The great question among dealers seems to be as to how long the present small-device prices will prevail, but whereas it has been almost unanimously believed that they will shortly drop, it is now held by the majority of dealers that labor, which cuts such a high figure in the prices on account of the infinite details in assembling, will be the determining factor in the maintenance of prices. In fact, radiator advances have been tentatively announced, the socket style to list at $10 instead of $9 each.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	List to +20%
1/5 to std. pkg	20% to list
Std. pkg	17% to 36%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
3/8	250	$5.00
1/2	250	7.50
3/4	100	10.00
1	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
-in. single trip	$75.00	$63.75— 69.75
-in. double strip	75.00— 82.50	72.00— 75.00
-in. single strip	100.00	85.00— 93.00
-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
-in. single strip	$75.00	$63.25 to $63.75
-in. double strip	78.25 to $78.75	71.25
-in. single strip	100.00	75.00 to 85.00
-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
3/8	$0.05½	1	$0.25
1/2	.06	1¼	.33
3/4	.09	1½	.40
3/4	.12	1¾	.47
3/4	.15	2	.55
3/4	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/8-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
1/2-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/8-in.—	$60.00	$30.00	$26.00–26.50
1/2-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08½
3/8	.08½
1/2	.08½
3/4	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft.	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$25.00 to $51.33

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $20.00
1/5 to std. pkg.	12.00 to 17.00
Standard package, 2200. List per 1000,	$21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$22.00
1/5 to std. pkg.	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41–$0.66
No. 18, full spools	.39– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.50–$25.09	$10.50–$17.00	$10.50–$15.00
12	20.20– 27.09	18.18– 23.22	15.15– 23.22
10	27.00– 32.40	24.30– 32.40	19.44– 27.45
8	33.12– 45.72	30.36– 45.72	26.50– 38.10
6	52.50– 72.36	48.13– 60.30	42.00– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00–$20.00	$13.00–$15.00	$11.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$26.75 to $34.75
25 to 50 lb	26.75 to 34.75
50 to 100 lb	25.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

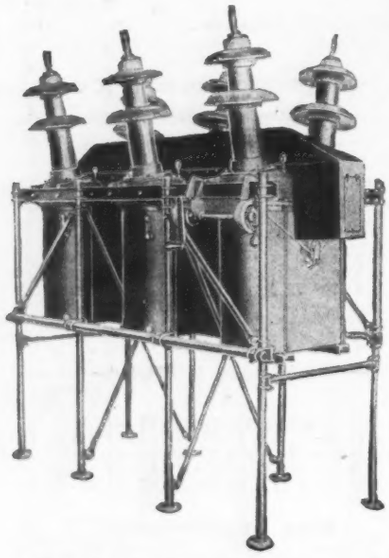
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Oil Circuit Breakers for Outdoor Applications

For controlling and protecting transmission lines, transformer banks and similar apparatus where the normal operating voltage is 44,000 volts or less, type D-16 oil switches and circuit breakers have been developed by the Condit Manufacturing Company of South Boston, Mass. They are of the three-pole type, arranged for manual direct or electrical remote control, and are furnished in these ampere capacities: 300 amp., 44,000 volts or less, and 300, 500 and 800 amp., 25,000 volts or less. Two forms of mounting are procurable—floor type, where the tanks rest upon the floor, and frame mounting, where the tanks are supported by a frame structure, as illustrated.

These switches and breakers essentially comprise three separate and identical units arranged in such relation to a common operating mechanism that simultaneous operation of the contact members is obtained. These switches are characterized, the maker states, by rugged construction, large expansion chamber with baffle gas vents, substantial tank construction, reversible and easily renewable arcing



FRAME MOUNTING, MANUAL DIRECT CONTROL, 300 AMP., 44,000 VOLTS

tips, and an efficient laminated brush, whose strong spring action facilitates rapid acceleration of the moving contact members upon the initial opening of the circuit.

Depending upon whether bushing type or oil-insulated type current transformers are used, trip coils are calibrated to trip at 5, 7 and 10 amp. or at 4, 5, 7 and 10 amp.

Inclosed Lighting Fixture for Gas-Filled Lamps

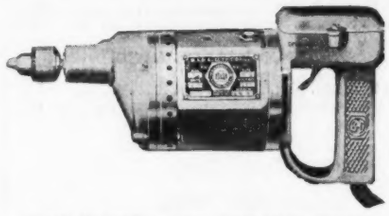
Instead of designing a lighting fixture to meet the requirements of several sizes of lamps and thereby effecting a compromise, Young & Egan of New York have developed units for each of the standard gas-filled lamps. This provides, the makers say, lighting of the finest-graded intensity and diffusion to fit individual requirements. As a result of thus designing the unit around the bulb, perfect diffusion is

INDIVIDUAL LIGHTING UNIT FOR EACH SIZE OF LAMP

said to be obtained, since the lamp filament in each unit is placed in the correct position. The unit is made in one piece of frosted glass between layers of clear glass. The light source is concealed, eliminating glare, and the fixture is shaped to give a minimum of light absorption with a maximum of illumination. The Sibley-Pittman Electric Corporation, Sixth Avenue and Thirteenth Street, New York City, is distributing this unit, which is known as the "Ray-O-Day."

High-Speed Drills with Pistol Grip and Trigger

Pistol grips and trigger switches are now obtainable on the $\frac{3}{16}$-in. and $\frac{1}{4}$-in. (4-mm. and 6-mm.) portable electric drills made by the Black & Decker Manufacturing Company of Baltimore, Md. Heretofore these features have been procurable only on the $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{3}{4}$-in. (9, 12, 15 and 22-mm.) sizes of this company's drills. These models are one-hand drills, the current being controlled by pulling the trigger, without any necessity for changing the position of the hand holding the tool. In



MAY BE HELD AND OPERATED WITH ONE HAND

addition, it is pointed out, this convenient control prevents breakage of drill bits frequently caused by the drill sagging on the bit when the operator changes the position of his hands to switch off the current.

These drills have $\frac{1}{3}$-hp. General Electric Company motors with series-compensated windings and operate on any current from direct to 60 cycles alternating. A vane impeller mounted on the armature shaft cools the machine by causing a forced circulation of air through the entire housing. The energy consumption of both models is 175 watt-hours. The no-load speed of the $\frac{3}{16}$-in. (4-mm.) model is 1600 r.p.m. and that of the $\frac{1}{4}$-in. (6-mm.) drill is 1200 r.p.m. Both drills weigh about $6\frac{1}{2}$ lb. (3 kg.) and come equipped with 15 ft. (4.5 m.) of duplex cable and a separable attachment plug.

Transformer for Welding Battery Connections

In order to afford convenient means for burning or welding straps and posts on storage batteries, the General Electric Company of Schenectady, N. Y.,

LIGHT IN WEIGHT AND PORTABLE

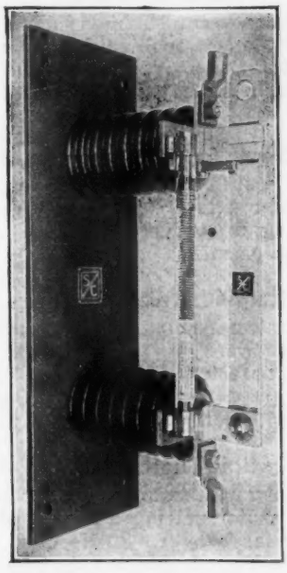
has developed a small lead-burning transformer, designed on the arc-welding process principle. It consists essentially of a small transformer wound for connection to the usual 110-volt, 60-cycle lighting circuit or 50-40

cycle circuits and with a low-voltage secondary of limited short-circuit capacity. The primary leads are a standard lamp cord with a separable attaching plug at each of its ends, one for connecting to the lamp socket and the other for attaching to the transformer. The secondary leads are light flexible cable, one being provided with a clamp for grounding to the battery plate and the other with a carbon fixed in a suitable wooden-handle holder.

After the transformer has been connected to the lighting circuit by the attaching plug, the ground side of the secondary is attached by means of a clamp and thumbscrew to the battery. This connection can be made on the strap, post or at any point on any of the plates electrically joined to the one where the welding operation is to take place. The lead is then fused as soon as it comes in contact with the carbon and can be "puddled" and worked with the carbon and the customary sticks of pig lead. This equipment requires between 500 watts and 600 watts when operating and when the operator is not working uses but 4½ watts. It is portable and weighs only 25 lb. (11 kg.) complete.

Safe Disconnecting Switches

Hazards attending the opening of disconnecting switches that are alive when the operator thinks they are dead have been eliminated in a type of disconnecting switch now being sold by Schweitzer & Conrad, Inc., 4431 Ravenswood Avenue, Chicago. It consists of a disconnecting switch shunted by a low-amperage "S. & C." fuse and provided with a lock so arranged that



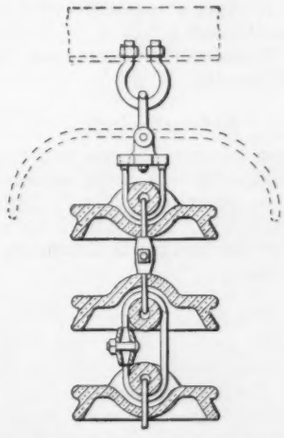
FUSE INTERRUPTS CURRENT IF SWITCH IS OPENED ON LIVE CIRCUIT

the disconnecting switch cannot be opened unless the fuse is in place. If the switch is opened when carrying energy, the current is shunted through the fuse and there interrupted when the fuse blows. The fuse, of course, only blows in case the disconnecting switch is carrying current when opened. This feature, it is pointed out, allows a low maintenance cost.

The manufacturers state that this idea can probably be applied elsewhere with good results. For instance, a field exists for an inexpensive method of interrupting load currents at moderate and high voltages without the use of expensive oil circuit breakers where opening the circuit is necessary only at rare intervals.

Connector Loops for Suspension Insulators

While the link type of insulator, typified by the Hewlett insulator, has always been attractive, it has not received as extensive use as might exist because the devices for connecting the disks have not quite met practical requirements. Lately, however, the Maxwell Engineering & Manufacturing



UPSET ENDS OF CONNECTORS CAN BE SECURELY HELD IN CLAMP

Company, 61 Broadway, New York City, has developed a fitting, illustrated herewith, which it claims overcomes this limitation. It consists of a flexible steel connector loop with upset ends which are gripped in a split clamp in such a manner that the greater the load the more firmly the ends are gripped. The sections of the split clamp are held together by a bolt and nut which is easily accessible even when the units are assembled. Because of these features it should be possible to assemble link-type insulator units quickly or even replace a unit in a string. In this type of insulator all stressed parts are in compression instead of tension, so that the danger of rupturing is greatly lessened.

Oscillating Motor-Operated Shears

Although not intended to compete with large rotary or knife-type power-driven cloth cutters, the electrically operated shears recently developed and placed on the market by the Sperry Gyroscope Company of Brooklyn, N. Y., are said to have a large field of application in cutting and trimming material of many kinds.

The shears, which are controlled by means of a push switch, consist of an electric motor and the shear blades, arranged so that the lower blade of the shears is stationary, being rigidly attached to the end frame of the motor. The upper blade is connected by a link and eccentric with the motor shaft.

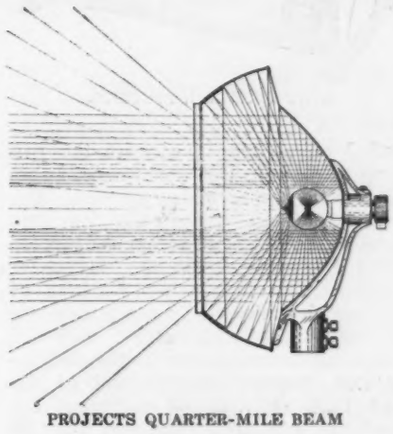
CUTTING EDGE IS WELL BACK ALONG THE BLADES, MAKING OPERATION SAFE

The motor runs at approximately 9000 r.p.m. and oscillates the movable blade at the same frequency. In cutting cloth and other fibrous materials, the effect of the rapid oscillation is said to be such that practically every fiber is individually severed and that tough materials, like canvas or linoleum, may be cut with nearly the same ease as silk.

Perhaps the most noteworthy feature of the shears, the maker says, is that although they will cut any material from silk to asbestos, they afford safety to the operator. The reason for this safety in operation is that the blades move only about $\frac{1}{16}$ in. (1.6 mm.) at the actual cutting edge. This cutting edge is well back along the blades, the ends of the blades being unsharpened.

Double-Reflector Light Projector

An intense main beam of light projected on the road ahead of the car for a distance of a quarter mile, a secondary beam covering the sides of the roadway and a third subdued illumination diffused immediately in front of the lamp are the three beams of illumination claimed for the automobile



PROJECTS QUARTER-MILE BEAM

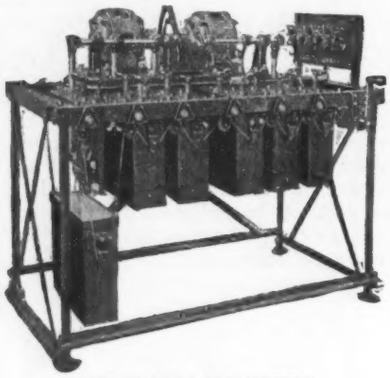
headlight now being marketed by J. T. Roffy, 340 Lewis Avenue, Brooklyn, N. Y. Two reflectors are used instead of one, the main one reflecting the rays from the bulb directly ahead, while the secondary or return-ray reflector facing

it aids in obtaining the diffused general illumination and the secondary wide-angle beam. As can be seen from the illustration herewith, direct visibility of the lamp filament is obscured. With the switch at "dim" this lamp is said to project an effective light having the same triple illumination characteristics as the "full" burning of the bulb, though, of course, in a less intense degree.

The maker points out that coupling the one reflector against the other of different angularity produces an I-section effect of great strength against warping. Thus the geometrical lines of reflectors act as the body of the lamp, permitting it to be assembled of fewer parts and eliminating considerable weight. Since lamp filaments vary not only in focal strength but in deviation of axis, an adjustment of the bulb is sometimes necessary. In the Roffy lamp adjusting the focus as well as turning the bulb and aligning the entire headlight can be done while the lamp is burning, without the necessity of opening the casing.

Oil Reversing Switch for Large Motors

A primary oil reverse switch has just been brought out by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., for high-voltage slip-ring motors such as are used in steel mills, mine hoists and similar service. It is designed for use with installations where it is desirable to have a remotely con-



UNIT-TYPE CONSTRUCTION

trolled oil switch to connect the primary winding to the lines for either reversing or non-reversing service. The switch consists principally of two three-pole switch units each operated by a high torque motor.

Among the interesting features of this switch indicated by the maker are the unit tank construction and the means of lowering the tanks for inspection, repairs and renewal of oil. Unit tank construction increases accessibility and saves time and labor in locating trouble and making repairs. Construction of the stationary and moving members is such that the arc is broken horizontally rather than vertically.

This construction, it is pointed out, allows the arc to rise to the point of rupture without burning parts not designed for such duty, and since the rupture takes place near the top of the oil, it is well away from all sediment. Hence frequent inspections and renewals are unnecessary. In case of serious damage to any single-pole unit it may be removed without disturbing any of the others. The tanks are lined with a heavy asbestos material to prevent grounding of any live parts should the tank be pushed out of place and also to serve as an additional safeguard in case of oil sludging.

The contactor panel at the extreme right of the switch is controlled from a master switch or push buttons. Very little current is said to be required as the motors used have high resistance rotors.

Notes on Recent Appliances

Desk and Wall Fans

Three desk and bracket models have been added to the line of fans marketed by the Kendrick & Davis Company, Lebanon, N. H.

Deflection Potentiometer

For measuring any voltage up to 1 volt the Northrup "millivolter," a portable potentiometer, has been developed by the Pyroelectric Instrument Company of Trenton, N. J.

Safety Switch

For use in installations not requiring a comparatively large amount of current a 30-amp., 125-volt inclosed safety switch has been placed upon the market by the Square D Company, Detroit, Mich.

Portable Conveyor

Loading, unloading, piling, storing and similar operations in handling bulk material and light articles may be accomplished by the scoop conveyor being manufactured by the Portable Machinery Company, Inc., Passaic, N. J.

Utility Stove

A small flat electric stove for boiling, frying and toasting is a recent addition to the line of heating devices manufactured by the National Electrical Heating Company, Ltd., of Toronto, Canada.

Light-Weight Cleaner

The "Torrington" electrically operated vacuum cleaner made by the National Sweeper Division of the Torrington Company, Torrington, Conn., has been supplemented by the "Miss Domestic," a new light-weight suction cleaner.

Electric Haulage System

To transport material in mines and similar locations the Electric Carrier Company, 220 Broadway, New York City, is manufacturing an electric hauling system consisting of cars and tracks.

Commercial Electric Furnace

Temperatures of 200 to 1100 deg. Fahr. (90 to 1090 deg. C.) are obtainable in the oven-type electric furnace recently put on the market by the Modern Equipment Company, Taunton, Mass., for annealing, enamel baking, drying and kindred operations.

Motor-Driven Lubricant Pumps

Centrifugal-type motor-driven lubricant pumps have been placed on the market by the Fulflo Pump Company, Blanchester, Ohio.

Heavy-Duty Safety Switches

Heavy-duty safety switches of the quick-break type are being made by the Palmer Electric & Manufacturing Company, Boston, Mass.

Laboratory Heater

An electric heater for use in chemical laboratories in heating round-bottomed flasks has been developed by the Wachtel's Physician Supply Company, Savannah, Ga.

Demagnetizer

To demagnetize gages, bearings, rings, cutters, etc., the "Bulldog" demagnetizer is being made by the Electric Brazing & Welding Machine Company, 30 Church Streeet, New York City.

Refillable Fuse

The "Yankee" refillable fuse is being made by the Metropolitan Electric Manufacturing Company, East Avenue and Fourteenth Street, Long Island City, N. Y.

Condenser for Radio Equipment

The Dubilier Condenser Company of 217 Center Street, New York City, is marketing a condenser for use with radio equipments.

Battery-Charging Rectifiers

For automatically charging storage batteries two types of rectifiers are being manufactured by the U. S. E. M. Company, 301 West Thirty-fifth Street, New York City.

Flexible-Shaft Machine

Equipped with scraping and cleaning burrs, a motor driving a flexible shaft is being made by R. S. Haskins, 547 West Washington Boulevard, Chicago.

Electrically Heated Water-Filled Radiators

Having current consumptions of from 638 to 935 watts, various sized water-filled radiators heated by electricity are being manufactured by Rapid Raditors, Ltd., Toronto, Ont., Canada.

Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Captain George Sykes, who has been in the United States nearly four years, attached to the British War Mission in a commercial capacity, sails for Europe in May. He has joined the Dutilh-Smith-McMillan Company, an international house, as London manager of its engineering and railroad departments. For many years prior to the war Captain Sykes was connected with electrical manufacturers in the sales and engineering departments and with power and traction corporations. He will be glad to hear from firms wishing to introduce their electrical products in Europe. His New York address is 50 Broad Street, and his London office is Central Buildings, Totehill Street, Westminster.

Captain Neale, civil engineer-in-chief's department, room 1004, Admiralty, London, S. W. 1, desires catalogs from manufacturers of electrical apparatus for purpose of reference.

A man in Denmark (No. 28,653) desires to secure an agency for the sale of electrical accessories, armatures and railway equipment.

A firm in Norway (No. 28,656) desires to secure an agency for the sale of electrical materials, such as cable, wire and accessories, and insulating materials. Correspondence may be in English.

A man in Belgium (No. 28,663) desires to secure an agency for the sale of material and supplies for tramways and electric lighting. Correspondence should be in French.

A firm in Norway (No. 28,680) wishes to purchase electric fixtures and electrical appliances (light, heat and power service). Payment, banker's confirmed credit in New York. Correspondence may be in English.

A merchant in Switzerland (No. 28,684) desires to secure an agency or to purchase electrical appliances. Correspondence should be in French.

A merchant in England (No. 28,688) desires to buy outright or to secure an agency for the sale of gramophone motors, flashlamps, bulbs and refills. He will pay cash for first order.

A merchant in Italy (No. 28,703) wishes to purchase a plant for the manufacture of caustic soda and carbonate soda by electrolytic or other cheaper system, to begin with a capacity output of from 3 to 5 tons of caustic soda per day. He also wishes to purchase machinery for the manufacture of soda drums. He desires to receive information as to the amount of electric energy required, cost of plant and the cost of manufacture per ton of soda. Correspondence may be in English.

A man in Australia (No. 28,705) whose business gives him a commanding position among mining, timber and other enterprises states that there is a great need for electrical generators and electrical equipment of all kinds, and he wishes to secure agencies for same.

A commercial association in Belgium (No. 28,697) wishes to communicate with manufacturers of electric motors in order to establish business connections.

CONSOLIDATION OF ENGLISH ELECTRICAL CONCERNS.—The English Electric Company, Ltd., Abchurch Yard, Cannon Street, London, E. C. 4, has been formed to consolidate under one direction and management the various interests of the following companies, in all of which a predominating control exists: Coventry Ordnance Works, Ltd., Dick, Kerr & Co., Ltd., Phoenix Dynamo Manufacturing Company, Ltd., United Electric Car Company, Ltd., and Willans & Robinson, Ltd.

FEDERAL TRADE COMMISSION CITES BATTERY CONCERN.—Declaring it has reason to believe from preliminary investigation that James B. Schafer, Detroit, operating under the trade name Universal Battery Service Company, with the intent, purpose and effect of misleading the public, adopted the trade name of a previously established competitor, the Universal Battery Company, Chicago, with only the word "service" added, and moreover imitated that competitor's advertising in style and color scheme, the Federal Trade Commission announces that it has issued formal complaint of unfair competition against Mr. Schafer. The Universal Battery Company, the complaint points out, had an established business in Michigan at the time that Mr. Schafer began to operate as the Universal Battery Service Company. Mr. Schafer was cited to appear before the commission in Washington on April 17.

THE OKONITE COMPANY, Canal Street, Passaic, N. J., manufacturer of insulated wires, etc., has filed notice of an increase in its capital from $600,000 to $1,500,000, to provide for expansion.

THE GASTON, WILLIAMS & WIGMORE ELECTRICAL ENGINEERING CORPORATION, 39 Broadway, N. Y., has filed notice with the Secretary of State of an increase in its capitalization from $500,000 to $1,000,000.

CAPT. A. U. WETHERBEE, who recently received his discharge from the Chemical Warfare Branch of the service and who was formerly chief engineer and assistant works manager of the Niagara Alkali Company, has become chief mechanical engineer of the Powdered Coal Engineering & Equipment Company of Chicago.

THE MORSE CHAIN COMPANY, Ithaca, N. Y., announces that it is advised by P. A. Morse of the Morse Engineering Company, its Western representative, St. Louis, Mo., that the Kansas City offices have been removed from the R. A. Long Building to more commodious rooms, Suite 211-212, Finance Building, with W. V. Warner as office district manager.

THE WAR TRADE BOARD announces that export licenses to Bulgaria, Turkey and the Black Sea ports will be granted only in exceptional cases for electrical appliances adapted for use in war and their component parts. For Bulgarian ports the same holds for telegraph and telephones and their component parts and materials for use therein.

THE GENERAL ELECTRIC EDISON CORPORATION OF CHINA has filed notice of a change in its corporate name to the China General Edison Company, Inc.

THE SHEPARD ELECTRIC CRANE & HOIST COMPANY has opened an office in the new Lexington Building, Baltimore, Md., with Norman P. Farrar, formerly district manager of the Philadelphia territory, in charge.

THE NORTH COAST ELECTRIC COMPANY, electrical jobber, Seattle and Tacoma, has opened a branch at 331 Everett Street, Portland, Ore., where a large stock of electrical supplies will be carried. L. S. Ruble, formerly with the Northwestern Electric Company and later with the Coast Steel & Machinery Company, has taken charge.

E. V. ADAMS succeeds G. K. Heyer as railway sales engineer of the Western Electric Company. He has been a Western Electric man since 1910, when he began in the railway sales department of the Chicago house. He was transferred to St. Louis in 1912 and the following year went to New York, where his headquarters will remain.

H. MOE AND C. A. BRIDGES, who were with the Phoenix Light Company of Milwaukee, Wis., have organized the Moe-Bridges Company at 60-64 Third Street, that city. The new company will manufacture lighting fixtures for the trade and will job glassware. Sample fixtures are now ready. It is not planned to sell electrical supplies or fixture parts.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, recently concluded a five-day "Victory" convention at the Bellevue-Stratford Hotel. Officers, branch office sales managers and department heads discussed and formulated plans to meet the increased demand for batteries for commercial purposes. A banquet at the Germantown Cricket Club closed the convention.

OFFICERS, SALES MANAGERS AND DEPARTMENT HEADS AT "VICTORY" CONVENTION OF ELECTRICAL STORAGE BATTERY COMPANY

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of the P. I. Perkins Company, 141 Milk Street, Boston, Mass., as its agent in Massachusetts, Connecticut and Rhode Island. The P. I. Perkins Company will handle in this territory the Roller-Smith Company's line of instruments, circuit breakers and meters and has arranged to have W. A. Blachford give his special attention to this line.

ROBERT L. STILES of Wilkinsburg, Pa., until recently connected with the Westinghouse Electric & Manufacturing Company, has purchased the stock of I. N. Butterworth in the Tri-City Electric Company and the Tri-City Electric Supply Company and is now actively engaged with E. M. Kunkel in the management of the two interests in Davenport, Ill. W. J. Ball, president of the Tri-City Electric Company and manager of the Moline house, has as his assistant as engineer and estimator J. H. Wright, who had charge of all electrical construction work for the C., B. & Q. railroad shops until the war.

and who has since then been with one of the large ammunition plants in the same capacity.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York City, has arranged to handle Emerson and "Northwind' Fans at its several Manhattan stores.

THE HARGREAVES BATTERY COMPANY, Kansas City, Mo., will occupy the new two-story building being erected by H. L. Tomlin on McGee Traffic Way.

THE WESTERN DRY BATTERY COMPANY, Seattle, Wash., manufacturer of "Bulldog" dry cells, has just moved into its two-story factory at Fifteenth Avenue West and Wheeler Street.

LAWFORD GRANT, who has severed his connection with the Eugene F. Phillips Electrical Works, Ltd., Montreal, was on Feb. 8 entertained at dinner at the Engineers' Club in that city by the staff of the company and presented with a mahogany clock.

JAMES M. BROWN, formerly Western sales manager of the Electric Cable Company, has recently been appointed special representative of the automotive equipment and electrical departments of the H. W. Johns-Manville Company, with headquarters in Chicago.

R. J. PARVIN, who for some time past has been connected with the Vulcan Soot Cleaner Company at Du Bois, Pa., has severed his connection with the home office and is now Wisconsin sales representative for both that company and the Vulcan Fuel Economy Company, with headquarters in the Collins Building at Fond du Lac, Wis.

THE ILLINOIS ELECTRIC COMPANY, Chicago, did not inclose a discount sheet with the new issue of its catalog which is just being distributed. As soon as price conditions become normal the discount sheet will be issued regularly and a copy will be sent to all those who received the catalog.

THE GENERAL ELECTRIC COMPANY has recently opened building No. 4, Fort Wayne, Ind., which will be devoted to the small-motor production department of the works. When the departments are completely installed, they will have an output of thousands of motors a week and the building will be the largest in the world devoted exclusively to the construction of small motors, it is reported.

THE TERRY STEAM TURBINE COMPANY makes the deferred announcement that since the death of Charles E. Hague in April, 1917, its interests in the Philadelphia district have been under the supervision of V. L. Sanderson, with headquarters at 605 Widener Building. James H. Weir has recently become associated with the company as assistant to Mr. Sanderson in that district.

PAUL W. KOCH & COMPANY is the name of the new concern at 19 South Wells Street, which is a combination of the former firm of Koch & Sandidge and the Electrical Sales Engineers, Inc. The new company, of which Paul W. Koch is president, is capitalized at $25,000. Formerly the Electrical Sales Engineers, Inc., handled the Condit, Esterline, Lewis and Roth lines. The Jiffy cutter was the principal line formerly handled by Koch & Sandidge. The new firm will specialize in labor-saving devices, particularly those which find application in industrial plants.

THE DAYTON (OHIO) FAN & MOTOR COMPANY announces its reorganization, and new officers as follows: Edwin O. Waymire, president; Lee Warren James, vice-president; Clyde C. Miner, secretary and treasurer. Mr. Waymire has been connected with the Dayton Fan & Motor Company in an official capacity since the very beginning of its business twenty-eight years ago. Mr. James is a Dayton attorney and financial man, and Mr. Miner has been connected with the Robbins & Myers Company for the past twenty years as general auditor and credit manager. It is the intention of the company to build immediately new factories, with a floor space of approximately 100,000 sq.ft., to accommodate its expanding business. Plans have already been laid to engage in the production of small motors, both alternating-current and direct-current, for the resale manufacture of household electrical appliances. An organization is being perfected, adequate buildings will be erected, and the company confidently expects that within six months it will be ready to produce these motors in large quantities.

Trade Publications

FANS.—A pocket-size booklet containing descriptive matter about its fans has been issued by the Century Electric Company of St. Louis, Mo.

FUSES.—A folder issued by J. H. Faw, 37 Warren Street, New York City, has for its subject "Fawsco" auto fuses, which are procurable in glass, fiber and link types.

LIGHTING FIXTURES.—A broadside describing and illustrating its line of lighting fixtures has recently been issued by the Perfeclite Manufacturing Company, Seattle, Wash.

TOGGLE BATTERY SWITCHES.—Harvey Hubbell, Inc., Bridgeport, Conn., has issued bulletin No. 16-7, covering Hubbell toggle battery switches and superseding bulletin No. 16-I.

FUEL ECONOMIZER.—Bulletin No. 151 has been brought out by the Green Fuel Economizer Company, 90 West Street, New York City, to tell about the advantages and construction of Green's fuel economizers.

LAMP GUARDS. — Flexco-Lox lamp guards and split-handle portables are the subject of a circular recently prepared by the Flexible Steel Lacing Company, 522 South Clinton Street, Chicago.

RAZOR-BLADE SHARPENER. — The Green automatic safety-razor-blade sharpening machine is the subject of a folder distributed by the American Sharpening Machine Company, 184 West Washington Street, Chicago.

PORTABLE DRILLS.—Information about six models of portable electric drills, all equipped with pistol grips and triggers, is contained in a new folder from the Black & Decker Manufacturing Company, Baltimore, Md.

AIR COMPRESSORS.—A two-stage automatic air compressor and a combination air compressor and buffer or grinder are described in a folder distributed by the United States Air Compressor Company, Cleveland, Ohio.

MAZDA LAMPS.—Information about Edison Mazda lamps, written in question and answer style, has been prepared and is being issued in booklet form by the Edison Lamp Works of the General Electric Company, Harrison, N. J., for users of its lamps.

HIGH-TENSION EQUIPMENT. — The Electrical Engineers' Equipment Company, 710 West Madison Street, Chicago, has issued in its Bulletin No. 108 information on outdoor switching equipment. Various combinations of lightning arresters, switches, fuses, choke coils and insulators are shown.

MOTORS.—Superseding Bulletin No. 39, No. 45 has been issued by the Electro-Dynamic Company, Bayonne, N. J., and gives ratings and dimensions of type "S" interpole constant and adjustable speed motors. Bulletin No. 100 is also available, describing type "S" interpole direct-current motors.

BUSBAR AND WIRING SUPPORTS.—The Delta-Star Electric Company, 2433 Fulton Street, Chicago, has just prepared bulletin No. 34, a forty-eight-page publication having for its subject unit-type outdoor-form busbar and wiring supports. More than 200 illustrations and line drawings are included in the new bulletin, which will be of special value to designers of outdoor substations.

ELECTRIC STEEL FURNACES.—The Pittsburgh Furnace Company of Pittsburgh, Pa., and Milwaukee, Wis., has issued a bulletin entitled "Electric Arc Furnace." The advantages of the arc type of electric steel furnaces for melting steel are compared with the crucible, the open-hearth furnace and the converter. The use of acid or basic-lined electric steel furnaces is also discussed.

POCKET-SIZE WIRING CHARTS.—A wiring chart for determining the proper wire size for use on circuits of 110-125-volt country-home lighting systems has just been prepared by the National Lamp Works of the General Electric Company, Cleveland, Ohio. It is similar to the low-voltage, 28-32-volt wiring chart for country homes distributed in July of last year. To aid in distinguishing the two charts, the new one is salmon-colored and is contained in an envelope on which the printing is done in dark red.

HEATING DEVICES. — A thirty-two-page illustrated list of American Beauty electrical heating appliances has been prepared by the American Electrical Heater Company, Detroit, Mich.

DIRECT-CURRENT AMMETERS AND VOLTMETERS.—The 4-in. "Imps," direct-current ammeters and voltmeters, made by the Roller-Smith Company, 233 Broadway, New York City, are described in bulletin No. 410, recently distributed.

TRANSMISSION TOWERS, ETC.—The Blaw-Knox products-booklet enumerates the variety of products manufactured by the Blaw-Knox Company, Pittsburgh, Pa. These products fall under main headings of fabricated steel, plate work, transmission towers, furnace equipment, buckets, steel forms and mixers.

ELECTRICAL SUPPLIES.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is now distributing its annual catalog of electrical supplies for 1919 in bound form instead of as loose leaves. The book is cloth-bound, contains 1276 pages and is thumb-indexed. Some of the sections in this very complete catalog cover lightning arresters, fuses and switches, carbon circuit breakers, safety switches, oil circuit breakers, switchboards, voltage regulators, switchboard accessories, meters, instruments and relays, distribution transformers, feeder regulators, transformer apparatus, insulating materials, line materials, railway accessories, lighting material, rectifier outfits, fans, heating appliances, ranges, industrial heating appliances, motors and controllers, etc.

New Incorporations

THE DALLAS (TEX.) ELECTRIC COMPANY has been incorporated with a capital stock of $10,000 by Elton Hoyt, R. H. Townsend and F. L. Richardson.

THE KESTING-KOPP-KEYSTER COMPANY of Philadelphia, Pa., has been incorporated with a capital stock of $25,000 to manufacture electric wire, etc. Edward Kramer is interested in the company.

THE FORT WAYNE (IND.) ELECTRIC EQUIPMENT COMPANY has been incorporated with a capital stock of $15,000 to buy and sell Delco light products. The incorporators are: Edwin H. Walker, Harry W. Meyers and A. Meyers.

THE ELECTROLABS COMPANY of Pittsburgh, Pa., has been incorporated by Waldes G. Swaney, Allen T. C. Gordon and David E. Ballinger of Pittsburgh. The company is capitalized at $25,000 and proposes to manufacture and deal in electrical appliances.

THE MORAN (IND.) ELECTRIC LIGHT & POWER COMPANY has been incorporated by Nicholas E. White, John C. Weida and J. White. The company is capitalized at $25,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

THE CALAIS (ME.) POWER COMPANY has been incorporated by William F. Hanson, Reed V. Jewett and Ashley St. Clair. The company is authorized to construct dams and power plants on Howard Mill stream in Calais. The capital stock of the company is not to exceed $50,000.

THE HARRIS ZINC PROCESS COMPANY of Michigan has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $125,000 and proposes to manufacture electric equipment of all kinds. The local incorporators are: George G. Steigler, J. H. Dowell and W. F. Keefe, all of Wilmington, Del.

THE FLORIDA BATTERY COMPANY of Jacksonville, Fla., has been incorporated with a capital stock of $10,000 to manufacture, buy and sell, recharge, repair, etc., electrical batteries of all kinds, and also to own and operate battery service stations and garages, and to deal in autos and motor vehicles. The officers are: Julian Perivitte, president; Fred Volz, vice-president, and Daniel B. Howes, secretary and treasurer.

New England States

PLYMOUTH, N. H.—A bill has been presented to the State Legislature for a charter for the Kineo Electric Company for the purpose of distributing electricity for lamps and motors in the towns of Rumney, Campton, Ellsworth, Thornton and Plymouth. The incorporators are Ezra C. Chase, Edward A. Chase, William J. Randolph, Alvin F. Wentworth, George P. Loveland and others.

LENOXDALE, MASS.—The Lenox Electric Company has secured a site in Lenoxdale on which it proposes to erect an emergency substation, which will be connected with the high-tension wires of the Pittsfield Electric Company. This will give the Lenox company two sources of supply, the other being from the power plant of the Monument Mills at Glendale.

LUNENBURG, MASS.—At the annual town meeting it was voted to sell the municipal electric lighting plant. Energy to operate the system is purchased from the Fitchburg (Mass.) Gas & Electric Company.

SPRINGFIELD, MASS.—The city property committee is considering the installation of an electric generator in the heating plant of the municipal group to furnish electricity for illuminating the city hall, the auditorium, the police station and fire department headquarters.

WESTFIELD, MASS.—Plans are under consideration by the officials of the Crane Company, paper manufacturer, for the installation of electric power to replace its present steam-power plant.

WESTFIELD, MASS.—Application has been made to the Municipal Light Commissioners by residents of Southwich to extend the municipal lighting service to that town. The officials of the Russell Falls paper mills have petitioned the commissioners for an extension of the power lines to Russell Falls to furnish power to operate the paper mills. Work is nearly completed on the installation of electric equipment at the municipal plant for utilizing energy from the power plant of the Turners Falls (Mass.) Power & Electric Company. The local plant will soon be closed down.

WATERBURY, CONN.—The Connecticut Light & Power Company has petitioned the State Legislature for extensive amendments to its charter giving it further control of the water power of the Housatonic River. The proposed amendments authorize the Housatonic Company to take water from the Ten Mile River at a point where it discharges below the dam of the New Milford Power Company. The company also asks for authority to install apparatus to draw up excess water of the stream to use it for the development of electricity, and also for permission to develop a water power at Shepaug and for the right to take land by eminent domain as the Rocky River Power Company was privileged to do, with the approval of the Superior Court. The company has a right to construct a series of dams between Shepaug and New Milford, and now it desires to build one dam which will best develop the power of the river.

Middle Atlantic States

BABYLON, N. Y.—The Babylon Railroad Company is negotiating with the town officials for a franchise permitting the company to furnish electricity for lamps and motors to the municipality. At present the service is furnished by the Long Island Lighting Company.

ELMIRA, N. Y.—The Elmira Water, Light & Railroad Company, it is reported, contemplates extensions to its power plant on East Water Street.

PERRY, N. Y.—The installation of an additional 500-kw. turbo-generator set is reported to be under consideration by the Perry Electric Light Company.

ROME, N. Y.—Plans are under consideration for improvements at the Rome State Custodial Asylum, including extensions to the electric power plant, to cost about $20,000; new stokers and other equipment at the boiler plant, $10,000, and new machine and repair shops, $20,000. Charles Bernstein is superintendent.

TOMPKINSVILLE, N. Y.—Bids will be received by the superintendent of lighthouses, Tompkinsville, N. Y., until March 28 for furnishing and installing on present runways one 10-ton, 28-ft.-span electric traveling crane, operated from the floor in plate shop at the general lighthouse depot, Tompkinsville.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

WATERTOWN, N. Y.—Plans are being prepared by the Northern New York Utilities, Inc., for an addition, 30 ft. by 38 ft., to its electric generating plant at Effley Falls, construction of steel penstock, 120 ft. long, revamping present dam, etc. J. B. Taylor is president.

SOUTH AMBOY, N. J.—Preparations are being made by the Pennsylvania Railroad Company for rebuilding the boiler plant and auxiliary steam buildings at its local railroad yards.

BLAIRSVILLE, PA.—Plans have been prepared by the Schwarzenbach-Huber Company of Allentown for an addition to its local plant, including a factory building, addition to engine room, etc., to cost about $95,000.

DENTON, MD.—Work will soon begin on improvements to the plant of the Peninsular Light & Power Company, controlled by the Eastern Shore Gas & Electric Company of Salisbury, including driving wells, installation of boiler, steam piping, etc. The boiler has already been purchased. F. W. Woodcock of Salisbury, general superintendent, will have charge of the work.

MYERSVILLE, MD.—Preparations are being made by the Hagerstown & Frederick Railway Company for the construction of a substation, car barn and freight station in Myersville, to cost about $10,000. Paul Smith of Frederick is superintendent of transportation.

ST. ALBANS, W. VA.—The St. Albans Water & Electric Company and the Campbell Brothers Ice Company have been consolidated under the name of the St. Albans Light, Water & Ice Company. The company is capitalized at $100,000 and proposes to improve and increase the output of the plants.

NORFOLK, VA.—The Bain Peanut Company, it is reported, would like to receive prices on 200-hp. Corliss engines and generators.

North Central States

BATTLE CREEK, MICH.—At an election to be held in April the proposal to issue $400,000 in bonds to establish a municipal electric light plant in Battle Creek will be submitted to the voters. The contract for street lighting will not expire for three years.

DETROIT, MICH.—The American Blower Company has secured a site along the Detroit Terminal Railroad tracks near Gratiot and Grinnel Avenues on which it proposes to build a plant, to cost about $750,000.

HIGHLAND PARK, (DETROIT P. O.), MICH.—Bids will be received by the city of Highland Park about May 1 for the construction of a hospital building and also a power and heating plant to cost about $300,000. M. J. Strum, 114 South Michigan Avenue, Chicago, Ill., is architect.

HUDSON, MICH.—Arrangements have been completed by the Southern Michigan Light & Power Company of Hudson for the erection of an electric transmission line from Hudson to Rollin and Manitou Beach. The contract price is $4,500 and $300 per mile for stub lines.

MARQUETTE, MICH.—Extensions are contemplated to the municipal electric light plant, to cost about $100,000.

YPSILANTI, MICH.—The City Council is considering drilling a new well, rebuilding wheel pit, installing twelve hydrants and new pumping machinery with electric auxiliary equipment. The cost is estimated at about $32,000. W. R. Caldwell is city engineer.

CLEVELAND, OHIO.—The Cleveland Automobile Company, East Thirty-first Street, is contemplating the construction of a factory, to cost about $500,000. E. McGeorge, 1900 Euclid Avenue, architect.

CLEVELAND, OHIO.—Plans have been prepared by A. A. Lane & Company of Cleveland, architects, for the erection of a battery building for the Willard Storage Battery Company, 246 East 131st Street, to cost about $150,000.

CLEVELAND, OHIO.—Plans have been prepared by Lockwood & Green, architects, 60 Federal Street, Boston, Mass., for an electric substation to be erected by the Mechanical Rubber Company, 8616 Lisbon Street, Cleveland. The cost is estimated at $160,000.

LIMA, OHIO.—The City Council has authorized bids advertised for an ornamental lighting system for North Main Street from the Public Square to the Pennsylvania Railroad. Bids will be received for both electric and gas lamps.

SANDUSKY, OHIO.—The Matthews Engineering Company, it is reported, has been awarded contract for furnishing 200 electric plants for Y. M. C. A. buildings.

BLUFFTON, IND.—The City Council is considering the purchase of a 1000-kw. turbo-generator for the municipal electric light plant. Extensions to the plant are necessary to meet the increasing demand for electrical service, including the sale of electricity to the Linn Grove Light & Water Company, recently organized.

EAST CHICAGO, IND.—Contract has been awarded by the Indianapolis Water Company to the Warner Construction Company of Chicago, Ill., for a water filtration plant in East Chicago for the East Chicago & Indiana Harbor Water Company. Chemical and filter houses will be erected and extensions made to the boiler house and also to the pumping station. One new boiler and two new pumps will be installed.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company is considering improvements to its building at 744 Washington Avenue.

PIERCETON, IND.—The Pierceton Light & Water Company, recently incorporated with a capital stock of $35,000, proposes to furnish light, power and water service in Pierceton. J. T. Brosnahan of Pierceton is interested.

CERRO GORDO, ILL.—The Central Illinois Electric Company of Decatur has applied to the Public Utilities Commission for approval of sale of its Cerro Gordo system, including the villages of Cerro Gordo and Oakley and intervening territory, to the Cerro Gordo Electric Light Company. The latter company has petitioned for a certificate of convenience and necessity to operate an electric light, heat and power system in Cerro Gordo and Oakley and for authority to issue $20,000 in capital stock. The company contemplates extensions to its plant equipment, transmission lines and service.

GALENA, ILL.—The Interstate Light & Power Company is contemplating the installation of a 5000-kw. steam turbine to replace the 2000-kw. turbine now in use.

ROCK ISLAND, ILL.—Arrangements have been made by the People's Power Company whereby the work of equipping the 180 houses for the United States Housing Corporation for electric and gas service, which was started last fall, will be completed.

GREEN BAY, WIS.—Manufacturers and others using electricity in Kewaunee, Algoma, Casco, Luxemburg and New Franklin have petitioned the Wisconsin Public Service Company of Green Bay to extend its electric transmission lines to those towns to furnish electricity for lamps and motors. Municipal plants are furnishing electrical service in Kewaunee and Algoma. C. R. Phenicle is general manager.

DALTON, MINN.—A franchise has been granted to Rude & Olsen to construct and operate an electric light plant in Dalton.

HAMPTON, IOWA.—The City Council is considering establishing a municipal electric light plant in Hampton.

MARSHALLTON, IOWA.—At an election to be held March 30 the proposal to issue $400,000 to establish a municipal electric light plant will be submitted to the voters.

KANSAS CITY, MO.—A large amount of electric wiring and fixtures, etc., will be required in connection with the erection of the new building for the Electric Theater.

ST. LOUIS, MO.—Plans have been prepared by the McQuay, Norris Manufacturing Company, 2803 Locust Stweet, for the erection of two or three factory buildings and power plant, near Oak Hill Railroad tracks and Cooper Street. A. J. Mummert is engineer.

FARGO, N. D.—At an election to be held April 1 the proposal to issue $150,000 in bonds for the construction of a municipal electric light plant will be submitted to the voters. F. L. Anders is city engineer.

LISBON, N. D.—Improvements are contemplated by the Lisbon Electric Light & Power Company, involving an expenditure of about $15,000.

SIOUX FALLS, S. D.—Work, it is understood, will soon be started on the erection of a 60,000-volt electric transmission line to connect the Sioux Falls division of the Northern States Power Company with the company's transmission system in southwestern Minnesota, between Pipestone and Dell Rapids, a distance of 35 miles. A new 3500-kw. steam turbine will be installed at the Sioux Falls power house to take care of the increased loads, which will be secured over the new line.

HOLDREDGE, NEB.—Bonds to the amount of $68,000 have been voted for the installation of an electric light plant in Holdredge. The equipment for the proposed plant, it is understood, will include one 220-kw. and one 110-kw. generator, driven by Corliss steam engines. About 70 miles of distribution lines will be erected. The installation of an ornamental lighting system in the business district is included in the plans.

OSHKOSH, NEB.—An election will soon be called to vote on the proposal to issue $45,000 in bonds for water works, electric lighting and sewers.

JUNCTION CITY, KAN.—The city has rejected all bids submitted for a generator set in connection with waterworks improvements. Power, it is understood, will be purchased. Burns & McDonnell, Interstate Building, Kansas City, Mo., are engineers.

OTTAWA, KAN.—Bids will be received by the city of Ottawa until March 24 for a 500-kw., two-phase, 60-cycle, steam-engine-driven electric generating unit.

SCRANTON, KAN.—An election will be held March 27 to vote on the proposal to issue $12,000 in bonds for the erection of a transmission line from Scranton to Burlingame.

Southern States

ALBANY, GA.—The Dougherty County Power Company, recently incorporated, is reported to have acquired the Porter Shoals property of the Albany Power & Manufacturing Company. Herman Riddell, J. A. Watson and Blair Foster are interested in the new company.

ATLANTA, GA.—Bonds to the amount of $1,000,000 have been voted by the city of Atlanta, the proceeds to be used as follows: For construction of an electric generating plant, $300,000; waterworks, $500,000; cyclorama and museum building, $100,000, and motorizing fire department, $100,000. H. L. Collier is chief of construction.

AUGUSTA, GA.—A site has been selected for the proposed municipal electric light plant.

PENSACOLA, FLA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 31 for improvements to the power plant at the local naval air station. The cost is estimated at about $85,000.

TAMPA, FLA.—Bids, it is reported, will soon be received by the McElroy Engineering Company, Giddens Building, for the construction of a sugar mill, including a 20-mile tramway. The cost of the project is put at $800,000. Owner's name not given.

PORT GIBSON, MISS.—At an election held recently the proposal to issue $25,000 in electric light bonds was carried.

EUREKA SPRINGS, ARK.—The Ozark Light & Power Company of Eureka Springs, recently organized with a capital stock of $100,000, is contemplating the construction of an electric light and power plant. James Bowen is president of the company.

NEW ORLEANS, LA.—A bond issue of $8,000,000 has been authorized by the Port Commissioners to complete the New Orleans industrial canal and to equip it with loading machinery and to install other mechanical apparatus.

NEW ORLEANS, LA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 11 for bedside call systems (annunciator system) in two buildings at the United States marine hospital at New Orleans, La.

SHAWNEE, OKLA.—The City Council is considering calling an election to submit to the voters the proposal to issue $500,000 in bonds for the construction of a municipal electric light plant.

CARBON, TEX.—Funds have been raised by the Commercial Club of Carbon for the installation of an electric light and power plant.

CLEBURNE, TEX.—The installation of an electric light plant in Cleburne is under consideration by E. J. Zimmerman of Cleburne and associates.

DALLAS, TEX.—The residents of Mount Auburn and Parkview additions have voted to establish a street car system to serve the needs of residents of both districts as well as that part of Dallas located east of the State Fair Grounds. The cost is estimated at about $125,000. Henry G. Wills is chairman of the committee.

DE LEON, TEX.—George H. Ford of Dallas, owner of the local electric light plant, contemplates the installation of new machinery and equipment, to cost about $40,000.

FORT WORTH, TEX.—The Board of Commissioners of Tarry County is considering the construction of an electric light and power plant in Fort Worth.

FORT WORTH, TEX.—Plans are under consideration by the Navy Department, Washington, D. C., for the construction of an electric transmission system and a one-story boiler and pump house in connection with the proposed argon production plant to be erected in North Fort Worth.

SAN ANGELO, TEX.—At an election to be held March 29 the proposal to issue $500,000 in bonds for the installation of an electric light plant and waterworks system will be submitted to the voters.

WICHITA FALLS, TEX.—The Wichita Falls Electric Company is contemplating extensions to its plant and system.

Pacific and Mountain States

BELLINGHAM, WASH.—The Whatcom County Commissioners have granted the Whatcom Railway, Light & Power Company permission to erect electric transmission lines along the county roads to Ferndale. Under the arrangements made electricity will be furnished to the county poor farm free of charge.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company is planning to extend its service to the McKinley Hill district. The cost is estimated at $3,600.

YAKIMA, WASH.—The Pacific Power & Light Company contemplates the erection of a 6600-volt, single-phase transmission line at once to furnish electricity to the ranchers in the Selah district. George C. Sawyer is local manager.

NEW PINE CREEK, ORE.—Preparations are being made by N. P. Jensen, owner of the local electric power plant, for the installation of a new power plant on Pine Creek, near the Taylor place, as soon as the weather will permit. Part of the machinery, it is understood, has already been purchased. The combined plants will have an output of 300 hp.

LOS ANGELES, CAL.—The Public Service Commission has authorized E. F. Scattergood, chief electrical engineer, to employ the power consulting board of engineers to assist in preparing plans for the proposed municipal power plant No. 2 to be erected in the San Francisquito Canyon. Contract for the steel penstock has been awarded.

LOS ANGELES, CAL.—The Southern California Edison Company of Los Angeles has started work on its hydroelectric construction project which will require an ultimate expenditure of $125,000,000. Bonds to the amount of $16,000,000 have been disposed of to carry on the first part of the work. During the next three years the company plans to expend $20,000,000 and in that time will develop 150,000 hp. in new hydroelectric plants. Work is now under way for a new plant on Kern River, 150 miles from Los Angeles, which will develop 40,000 hp., in addition to the Big Creek plants. The Big Creek plant No. 2, in Fresno County, now consists of two plants with a total output of 88,000 hp., each plant containing two 22,000-hp. generators. It is proposed to install an additional generator of the same size in plant No. 2, which will necessitate the construction of an additional pipe line, requiring 1100 tons of steel. Later a similar unit will be required at power plant No. 1 under practically the same conditions. The development of Big Creek plant No. 3, which will be next in order, will use all the water supplied by Huntington Lake and will utilize it after it passes through the two present power houses. The combined head of power houses Nos. 1 and 2 is 4000 ft. The first development at power house No. 3 at Big Creek provides for 68,000 hp., to be ultimately increased to 200,000 hp., and includes the diversion of the waters of Pitman Creek into Huntington Lake, increasing the amount of water available for storage purposes. The company is carrying out the recommendation for hydroelectric development made by Major George F. Sever of the War Industries Board of the United States government last fall. W. A. Breckenridge of Los Angeles is president and general manager.

OAKDALE, CAL.—The Oakdale Irrigation District, it is reported, has decided to join with F. B. Pattee and Burton Smith in connection with a hydroelectric development on the north fork of the Stanislaus River, to cost about $1,000,000. The project includes the construction of a dam 1000 ft. long and 200 ft. high, to impound 15,000 acre-ft. of water and to develop 15,000 hp. B. Smith of Oakdale is engineer.

BURKE, IDAHO.—The power plant of the Federal Mining & Smelting Company near Upper Burke was recently destroyed by fire, causing a loss of about $20,000.

RONAN, MONT.—The installation of an electric light plant is under consideration. Stephen Walner of Butte is reported interested.

NUCLA, COL.—The installation of an electric light plant in Nucla is under consideration. Lincoln Vestal is interested.

SEDGWICK, COL.—Plans are being prepared by the Henningson Engineering Company, National Bank Building, Omaha, Neb., for the construction of an electric light plant and waterworks in Sedgwick. An election will soon be called to vote on an issue of $30,000 in bonds for same.

Canada

SQUAMISH, B. C.—Contracts, it is understood, will soon be awarded by the Department of Railways, Victoria, for construction of dam, intake water supply system, hydroelectric power plant and transmission system in Squamish. A. E. Proctor of Victoria is engineer.

BARRINGTON, N. S.—The installation of an electric lighting system in Barrington, to cost about $10,000, is under consideration.

MARKHAM, ONT.—A by-law has been approved by the ratepayers authorizing an appropriation of $5,000 to secure power from the Hydro-Electric Power Commission.

TODMORDEN, ONT.—The Amalgamated Ratepayers' Association of York Township is negotiating with the Hydro-Electric Power Commission of Ontario for the installation of an electric lighting system throughout the township. S. D. Durham is chairman.

BRODERICK, SASK.—The Town Council is considering the question of establishing a municipal electric light plant in Broderick.

ESTEVAN, SASK.—The neighboring municipalities have petitioned the provincial government to request the Dominion Power Board to investigate the development of power at the coal fields in southern Saskatchewan for the purpose of transmitting power to Moose Jaw, Regina, Weyburn and intervening points near Estevan. C. A. Manlove of Estevan is interested.

MELTFORT, SASK.—The purchase of electrical equipment is under consideration by the Town Council.

MILDEN, SASK.—Plans are under consideration by the Town Council for the installation of a municipal electric light plant in Milden.

Miscellaneous

HONOLULU, HAWAII.—At the annual meeting of the Hawaiian Electric Company the stockholders will be asked to vote on the proposal to increase the capital stock of the company to $5,000,000. It is proposed to issue $500,000 immediately to provide funds to take care of improvements now under way and contemplated.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until April 7, under circular 1264, for furnishing boilers, cable, rope, wire, lamp cord, etc. Bids will also be received until March 27, under circular 2206, for furnishing 7500 ft of cable, 600 lb. plate washers, etc. Further information may be obtained at the above office.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 28, 1919)

1,292,884. BAKER'S-OVEN-LAMP ELECTRIC CONNECTION; Charles P. Robson, Philadelphia, Pa. App. filed Oct. 17, 1917. Will withstand without short-circuiting conditions of high heat and presence of steam.

1,292,888. AUTOMATIC CURRENT REGULATOR FOR SEAM-WELDING MACHINES; Charles D. Ryder, Covington, Ky., and Ralph B. Kersey, Cincinnati, Ohio. App. filed Oct. 24, 1918. Produces seam weld substantially uniform in character throughout its length.

1,292,892. ELECTRIC WELDING MACHINE FOR FORMING ELECTRICAL CONTACTS; William F. Hosford, Oak Park, Ill. App. filed Sept. 24, 1915. Used particularly with switch contact springs.

1,292,911. ATTACHMENT PLUG; William A. Stacey, Chicago, Ill. App. filed April 27, 1918. For heavy duty.

1,292,921. ELECTRIC WELDER; Carl H. Thornblade, Seattle, Wash. App. filed Aug. 4, 1917. Contact terminals through which application of current to yielding terminals is controlled may be applied only for limited time.

1,293,010. CONVERTIBLE ELECTRIC SADIRON AND HEATING AND COOKING STOVE AND LAMP; Jacob Bloch, Cincinnati, Ohio. App. filed Jan. 7, 1918. Simple in construction and easy to manipulate.

1,293,038. BRUSH HOLDER; Emerson L. Clark, Lakewood, Ohio. App. filed April 19, 1916. Brush applied firmly to commutator.

1,293,117. PRODUCTION OF METALLIC TUNGSTEN; Frederick G. Keyes, Cambridge, Mass. App. filed Feb. 11, 1914. Tungsten compound dissolved in ionizing medium at approximately 1200 deg. to 1400 deg. C. and solution thus formed electrolyzed.

1,293,052. ELECTROMAGNETIC MECHANISM; John L. Dinsmoor, Brooklyn, N. Y. App. filed Aug. 1, 1914. Useful in controlling feed of arc-lamp carbon or carbons.

1,293,060. TELEPHONE SYSTEM; George D. Edwards, East Orange, N. J. App. filed Jan. 4, 1918. Efficiency of transmission between plurality of connected stations not materially affected by variations in number of stations involved.

1,293,098. RELAY; Abraham N. Hovland, Christiania, Norway. App. filed May 1, 1913. Using one or more photo-electric cells.

1,293,112. METHOD OF AND APPARATUS FOR CONTROLLING ELECTRIC MOTORS; Arthur C. Keller, Milwaukee, Wis. App. filed Feb. 25, 1918. Applicable in hoisting and lowering loads and where dynamic braking is utilized.

1,293,120. COMBINED BELL AND BUZZER; William J. Klein, Buffalo, N. Y. App. filed May 1, 1917. Common return wire utilized.

1,293,141. CLOSET; Alexander McGary, New York, N. Y. App. filed Aug. 4, 1913. Incinerates refuse.

1,293,164. ELECTRIC METALLURGICAL FURNACE; William E. Moore, Pittsburgh, Pa. App. filed July 30, 1917. Combines advantageous features of both induction and arc type.

1,293,171. HAIR-WAVING DEVICE; Josephine Nimmerfroh, Lenox, Mass. App. filed Sept. 4, 1918. Hair may be readily entered or removed without entangling.

1,293,193. COMMUTATOR WIPER; Karl H. Poyas, Los Angeles, Cal. App. filed March 23, 1918. For Ford's timing systems.

1,293,195. SWITCH-CONTROL SYSTEM; Ralph L. Quass, Hawthorne, N. J. App. filed July 5, 1916. Primarily for telephone systems.

1,293,205. AUTOMATIC CUT-OUT; Oliver A. Ruff, Dayton, Ohio. App. filed Feb. 23, 1915. Adapted for use in charging circuit of storage battery.

1,293,296. DEVICE FOR AUTOMATICALLY CONTROLLING THE MOVING OF HEAVY OBJECTS; Fridtjov Anderson, Drobak, near Christiania, Norway. App. filed April 12, 1915. By means of comparatively light controlling or sighting apparatus.

1,293,309. SNAP SWITCH; Reuben B. Benjamin, Chicago, Ill. App. filed Oct. 20, 1916. Arcing when contact is broken reduced to minimum.

1,293,310. HIGH-SPEED TRANSMISSION; Erastus S. Bennett, New York, N. Y. App. filed Nov. 8, 1916. For high rotative velocities, whether to reduce speed or otherwise.

1,293,320. SOLDERING IRON; William A. Braun, Dover, Ohio. App. filed June 24, 1918. Resistance coil or heating element may be renewed.

1,293,323. CONTAINER FOR X-RAY FILMS; Arthur W. Buck, St. Louis, Mo. App. filed April 11, 1917. Envelop opaque to ordinary light but has portion permeable by invisible rays.

1,293,328. TIMER; Solomon A. Campbell, Newton, Mass. App. filed July 10, 1918. For internal-combustion engines.

1,293,346. ELECTRICAL SELECTING AND RECORDING APPARATUS; Guy S. Cornish, Cincinnati, Ohio. App. filed July 16, 1917. Single selector common to plurality of printers provided.

1,293,352. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App. filed Dec. 29, 1910. Dynamo or generator may be automatically governed to charge storage battery properly and operate lamps, etc.

1,293,356. APPARATUS FOR REGULATING AUTOMATICALLY THE CUTTING OF HOLES IN JACQUARD CARDS; Arvid G. Damm, Ronninge, Sweden. App. filed June 24, 1918. For textile purposes.

1,293,387. ELECTROMAGNETIC SIGNALING DEVICE; Charles J. Erickson, Chicago, Ill. App. filed Dec. 15, 1916. Of type comprising polarized ringers for substation telephone sets.

1,293,388. CIRCUIT BREAKER; James E. Evans, Artesia, Cal. App. filed Sept. 27, 1917. Thermostatically controls electric heating circuits in incubators.

1,293,390. TELEPHONE SIGNALING SYSTEM; Samuel H. Everett, Brooklyn, N. Y. App. filed March 11, 1915. May be associated with sources of ringing current of widely different frequencies, and relays for tripping or disconnecting ringing current from called line upon response of subscriber.

1,293,415. TELEPHONE TRUNKING SYSTEM; Bernard C. Groh, Chicago, Ill. App. filed March 6, 1915. Automatic toll switching system provided.

1,293,419. STORAGE-BATTERY GRID; Eugene Handler, Newark, N. J. App. filed May 5, 1916. Of the Faure type.

1,293,428. AUTOMATIC REGULATOR; Clark T. Henderson, Milwaukee, Wis. App. filed Nov. 22, 1913. For use in automobile lighting systems employing generator and storage battery to supply energy for lamps.

1,293,440. RESISTANCE; Albert J. Horton, White Plains, N. Y. App. filed May 24, 1916. For phonographs and other mechanisms.

(Patented Feb. 4, 1919)

1,293,446. FUEL-SUPPLY REGULATOR FOR STEAM BOILERS; Emil J. Hugo, Philadelphia, Pa. App. filed July 18, 1918. Electrically operated ball valve gives accurate control.

1,293,456. VAPORIZER; William D. Johns, Seattle, Wash. App. filed April 11, 1917. Combined vaporizer and carburetor for internal-combustion engines allows use of kerosene, wood alcohol, etc.

1,293,458. TELEPHONE CIRCUIT; Kenneth S. Johnson, Jersey City, N. J. App. filed Aug. 16, 1917. Independent potential opposes drop of potential through transmitter. Eliminates use of infinite-capacity condenser.

1,293,462. GALVANIC CELL; Morduch L. Kaplan, Brooklyn, N. Y. App. filed July 11, 1918. Manganese peroxide depolarizer for Leclanché type cells used for portable lights and pocket lamps.

1,293,463. GALVANIC CELL; Morduch L. Kaplan, Brooklyn, N. Y. App. filed July 11, 1918. Depolarizer combines high efficiency of the hydrate with density of the anhydrous kind.

1,293,467. SYSTEM OF SELECTIVE ELECTRICAL DISTRIBUTION; Charles F. Kettering and William A. Chryst, Dayton, Ohio. App. filed Nov. 20, 1912. Vibrating-spark effect secured only when timer of internal-combustion engine is off contact.

1,293,494. MACHINE-SWITCHING TELEPHONE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed April 24, 1917. Common trunks increase load factor of system.

1,293,499. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Feb. 18, 1914. Rotary-magnet interrupter common to a plurality of switches.

1,293,510. SAFETY LOCKING DEVICE FOR VEHICLES; Edward R. Moores, Albany, N. Y. App. filed July 25, 1917. Alarm is sound if safety device is disturbed.

1,293,532. CONTROLLING MEANS FOR ELECTRIC MOTORS; Frederick G. Peck, Philadelphia, Pa. App. filed Sept. 25, 1916. Field current of motor controlled by snap switch actuated by part of controller.

1,293,538. ARC-WELDING ELECTRODE HOLDER; James E. Pierce, Albion, Mich. App. filed Nov. 12, 1918. Readily and easily opened to receive electrode.

1,293,545. CALLING DEVICE; Osvalt E. Rasmussen, West Hoboken, N. J. App. filed July 24, 1917. For automatic and semi-automatic telephone systems.

1,293,547. MECHANICALLY OPERATED ELECTRICAL SWITCH; Edward B. Reese, Indianapolis, Ind. App. filed Nov. 8, 1915. Fluid pressure in an internal-combustion engine utilized to operate electrical switch.

1,293,562. METHOD OF MAKING JACKETS FOR ENGINE CYLINDERS; Frederick Seigel, Irvington, N. J. App. filed July 12, 1917. Jackets electrolytically deposited directly on cylinders.

1,293,574. TIMER FOR INTERNAL-COMBUSTION ENGINES; Ira T. Swartz and Alvie T. Wallace, Indianapolis, Ind. App. filed Oct. 22, 1917. Timer held in place against accidental or intentional change.

1,293,587. REVERSE-CURRENT AND LOW-VOLTAGE CIRCUIT BREAKER; Albert E. Weaver, Indianapolis, Ind. App. filed July 20, 1914. Apparatus contained in tubular iron shell acts without arcing.

1,293,597. TELEPHONE SYSTEM; Bernard D. Willis, Chicago, Ill. App. filed Nov. 28, 1913. For systems in which connection is established in whole or in part through automatic switches.

1,293,620. AUTOMATIC TELEPHONE SYSTEM; Winfred T. Powell, Chicago, Ill. App. filed Feb. 14, 1916. For systems made up in part of poly-station lines equipped for prepayment service.

1,293,630. TELEPHONE-EXCHANGE SYSTEM; Gerald Deakin, London, Eng. App. filed Aug. 16, 1917. Automatic switching means provided.

1,293,649. FILTERING APPARATUS; Carolyn S. Smith, Brooklyn, N. Y. App. filed May 10, 1913. Galvanic action aids in purifying water.

1,293,651. FILTERING APPARATUS; Carolyn S. Smith, Brooklyn, N. Y. App. filed April 6, 1914. See above patent.

(Patented Feb. 11, 1919)

1,293,689. APPARATUS FOR THERAPEUTICALLY APPLYING DIATHERMIC CURRENTS; Gustav Bucky, Berlin, Germany. App. filed June 4, 1914. Heating at electrodes prevented by periodically weakening or interrupting current.

1,293,691. CIRCUIT BREAKER AND SWITCH; George A. Burnham, Saugus, Mass. App. filed Aug. 23, 1915. Controlling circuit opened when circuit-breaker becomes closed.

1,293,692. TRANSFORMER; George A. Burnham, Saugus, Mass. App. filed Sept. 28, 1916. Plates composing core held in fixed relation to each other, independently of windings.

1,293,697. OVERLOAD DEVICE; Harry R. Canfield, Cleveland, Ohio. App. filed April 19, 1916. Time-interval elements hermetically sealed in container to exclude dust, dirt, moisture, etc.

1,293,698. ELECTROMAGNETIC DEVICE; Harry R. Canfield, Cleveland, Ohio. App. filed April 22, 1916. Operates switch only when current is within predetermined limit.

1,293,717. SPEED MEASURING AND CONTROLLING DEVICE; James H. Core, Nashville, Tenn. App. filed Oct. 10, 1917. Centrifugal device controls ignition of internal-combustion-engine vehicles.

1,293,718. INTAKE-MANIFOLD GASKET; Louis E. Cornu, Enid, Okla. App. filed April 15, 1918. Electric resistance wires heat fuel as it passes through gasket opening.

1,293,720. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App filed Feb. 16, 1912. For variable-speed generators.

1,293,744. APPARATUS FOR LOCALIZING SUBMERGED SUBMARINES; Bradley A. Fiske, United States Navy. App. filed May 23, 1917. Submerged microphone detects presence of submarine.

1,293,747. BATTLE TRACER; Hannibal Ford, Brooklyn, N. Y. App. filed Aug. 4, 1914. Instrument moves over chart and indicates at each instant both nautical position of ship on which instrument is placed and of another ship or object.

1,293,764. REGULATING MEANS FOR DYNAMO-ELECTRIC MACHINERY; David Hall, Wilkinsburg, Pa. App. filed Oct. 6, 1916. Brushes can be placed under the center of off-set tips of interpole to provide denagnetizing turns in the armature.

1,293,767. PROTECTIVE MEANS FOR BRIDGE-TYPE PHASE SPLITTERS; Max Hartenheim, Pittsburgh, Pa. App. filed Feb. 10, 1916. Guards against excessive voltage stresses or strains at unbalanced loads.

1,293,770. COMMUTATOR CYLINDER FOR DYNAMO-ELECTRIC MACHINES; Rudolph E. Hellmund, Swissvale, Pa. App. filed Sept. 27, 1916. High-voltage commutator cylinder has safe creepage path, although length is decreased.

1,293,781. INCANDESCENT ELECTRIC LAMP; Milton A. Hoyt, Bloomfield, N. J. App. filed July 11, 1916. Rapid method of forming connections between incandescent elements and leading-in wires.

1,293,794. ELECTRICAL SWITCH; William Kaisling, Chicago, Ill. App. filed Oct. 27, 1913. Particularly for ignition and light circuits on automobiles.

1,293,817. CALL-DISTRIBUTING TELEPHONE SYSTEM; John H. Levis, Jr., Rochester, New York. App. filed Oct. 25, 1916. Special apparatus for different classes of subscribers.

1,293,818. ELECTRIC IRON; Cyril N. Lewis, Ridgefield Park, N. J. App. filed Aug. 1, 1917. Circuit of heating element automatically interrupted when iron is not in use.

1,293,842. CIRCUIT INTERRUPTER; Howard G. MacDonald, Murraysville, Pa. App. filed March 9, 1918. Common operating rod for several contact members prevents transmission of arc explosive forces.

1,293,862. WIRE CONNECTOR; Joseph Moore, Baltimore, Md. App. filed Dec. 20, 1917. Wire held firmly between spring clips.

1,293,825. TESTING SYSTEM; Eric R. Lundius, Brooklyn, N. Y. App. filed April 6, 1918. For separately testing portion of telephone lines.

1,293,872. METHOD OF ELECTRICALLY UNITING METAL BODIES; Thomas E. Murray, New York, N. Y. App. filed April 27, 1918. Only one body is electrically fused for the joint.

1,293,881. VAPOR RECTIFIER; Harold A. Newcomb, Wilkinsburg, Pa. App. filed May 6, 1915. Arcs and electrical discharges readily controlled in vacuum electric apparatus.

1,293,896. ELECTRIC FLUID HEATER; Jens A. Paasche, Chicago, Ill. App. filed Oct. 25, 1915. Heats air and coating material in pneumatic coating apparatus.

1,293,912. REMAGNETIZING DEVICE; James L. Porter, Los Angeles, Cal. App. filed March 20, 1918. For remagnetizing permanent magnets of Ford motors.

1,293,929. SYSTEM OF CONTROL; Lynn G. Riley, Wilkinsburg, Pa. App. filed April 23, 1915. Relates to automatic series-parallel control of electric railway vehicle motors.

1,293,930. SYSTEM OF CONTROL; Lynn G. Riley, Wilkinsburg, Pa. App. filed March 4, 1916. Prevents undesirable rushes of current and too sudden acceleration of electric railway vehicle during predetermined portion of its accelerating period.

1,293,943. TROLLEY HANGER; William Schaake, Pittsburgh, Pa. App. filed June 30, 1915. Simple and effective clamping device.

1,293,945. MEANS FOR MINIMIZING INDUCTIVE INTERFERENCE; Charles F. Scott, New Haven, Conn. App. filed Jan. 2, 1915. Return flow of trolley currents of railway system may be substantially confined to track rails.

1,293,964. ELECTRIC HEATER AND COOKER; Perl M. Spink, Worthington, Minn. App. filed Feb. 23, 1918. Automatically varies distance between electrodes in accordance with heat developed.

1,293,970. SIGNAL-CONTROL APPARATUS; George Stickels, Astoria, N. Y. App. filed Jan. 31, 1918. Electrically operated by steering gear on clutch of vehicle.

1,293,973. SWITCH AND BRUSH MOUNTING FOR ELECTRIC MOTORS; Edward Strohacker and Louis Strohacker, Freeport, Ill. App. filed May 18, 1917. Novel pole changer and reversing switch for use on small horsepower motors.

1,293,989. LAMP SOCKET; Frank W. Turner, Kansas City, Mo. App. filed Nov. 6, 1916. Switch mechanism operated either by pull chain or ordinary switch key.

1,293,991. INDICATING MEANS; Louis J. Vandermyde, Morrison, Ill. App. filed Jan. 14, 1918. Gages amount of liquid in tank or container.

1,294,015. ELECTRIC HEATER FOR HUMIDIFIERS; Daniel H. Young, Manchester, Iowa. App. filed Feb. 2, 1918. Supplies steam or mixture of steam and electrolytically separated oxygen gas.

1,294,020. ARC LAMP; Christian Aalborg, Wilkinsburg, Pa. App. filed March 20, 1913. Has control mechanism in which frictional resistance is substantially minimized.

1,294,045. LOCK SWITCH; John F. Cavanagh, Meriden, Conn. App. filed March 14, 1918. Particularly for use on motor vehicles.

1,294,053. ELECTRIC SWITCH; Frederick W. Cole, Newton Highlands, Mass. App. filed Jan. 3, 1916. For use as shunt switch for fire-alarm signal boxes.

1,294,072. ELECTRICAL INSTRUMENT; Harry A. Ewen, London, Eng. App. filed May 16, 1917. Inclosed in vacuum bulb and operates on thermic principle.

1,294,176. ELECTRIC SWITCH; Joseph Sachs, Hartford, Conn. App. filed Dec. 19, 1916. Live circuit inaccessible when replacing fuses.

1,294,177. WAVE DETECTOR; Wilhelm Schloemilch, Berlin, Germany. App. filed March 13, 1912. Operating without auxiliary source of current.

1,294,185. PANELBOARD AND PANELBOARD CONSTRUCTION; Henry F. Starrett, Chicago, Ill. App. filed May 11, 1917. Assembled from stock units.

1,294,197. TELEPHONE MOUTHPIECE; Olaus Thokle, Mandal, Norway. App. filed Aug. 16, 1916. Inner opening communicates with diaphragm chamber through plurality of separate channels.

1,294,204. TROLLEY; Artemas B. Upham, Malden, Mass. App. filed March 31, 1915. Two trolleys of trackless car simultaneously engage two wires.

1,294,207. FIRE ALARM; William H. Vogtlander, Alexandria, Va. App. filed May 15, 1918. Detectors when fused close an electrical circuit.

1,294,213. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; George H. Whittingham, Bancroft Park, Md. App. filed Oct. 15, 1915. Sensitiveness of relay increased after lapse of sufficient time to permit initial rush of starting current to subside.

1,294,250. ARC-WELDING ELECTRODE; Clarence V. Elliott, Schenectady, N. Y. App. filed July 22, 1918. Welding metal combined with small quantity of material having high electron emissivity when heated.

1,294,269. ELECTRIC OVEN; Julius W. Hopkins, Cleveland, Ohio. App. filed May 8, 1918. Uses bulb-type grids.

1,294,277. MAGNETO-STARTING MECHANISM; Lancelot Johnson, Islington, London, Eng. App. filed Nov. 12, 1918. Separately operated parts eliminated.

1,294,282. MAGNETO IMPULSE STARTER; Benjamin Lawrence, Leyton, Eng. App. filed Nov. 12, 1918. Magneto armature has rapid angular movement given to it when engine is slowly cranked.

1,294,295. AUTOMATIC TELEPHONE EXCHANGE; George W. Lorimer and James H. Lorimer, (deceased), Piqua, Ohio. App. filed Nov. 26, 1901. Relates to employment of central energy for talking, signaling and adjusting central-exchange apparatus.

1,294,296. AUTOMOBILE HORN; Ernest Monteleone, Jersey City, N. J. App. filed Feb. 21, 1917. Sounding diaphragm has anvil and electromagnet operating in presence of anvil.

1,294,305. INVERSE TIME-LIMIT RELAY; Lewis T. Robinson and Clyde V. Hardy, Schenectady, N. Y. App. filed Sept. 15, 1914. Minimum time of engagement of contact members simply, conveniently and accurately adjusted.

1,294,326. ELECTRICAL OSCILLATION GENERATOR; Joseph Methenod, Paris, France. App. filed Nov. 28, 1917. Power and the stability of generator increased.

1,204,342. COMBINATION IGNITION AND LIGHTING SWITCH; William Kaisling, Chicago, Ill. App. filed May 6, 1914. Has interlocking features to control various operations.

(Patented Feb. 18, 1919)

14,593. (Reissue.) METHOD OF LOCATING SPECIAL TRANSPOSITION POINTS; Hughes Mouradian, Philadelphia, Pa. App. filed Jan. 2, 1917. Obtains substantial neutralization of disturbances, especially those due to electrostatic induction.

1,294,409. APPARATUS FOR UNITING METAL BODIES; Lawrence P. Crecelius, Cleveland, Ohio. App. filed April 30, 1915. Adapted particularly for rail bonding purposes.

1,294,432. SAFETY FUSE; Alfred L. Eustice, Chicago, Ill. App. filed March 14, 1917. Refillable plug type; may be opened for examination or removal without disturbing fuse link.

1,294,444. ATTACHMENT PLUG; William Goetzelman, Chicago, Ill. App. filed May 4, 1917. Firm and stable connection of plug and socket provided.

1,294,471. CIRCUIT BREAKER FOR IGNITION APPARATUS; Albert G. Karkau, Cleveland, Ohio. App. filed July 23, 1917. Bearing is not affected by action of current passing through arm carrying roller.

1,294,482. STOP-MOTION DEVICE FOR LOOMS; Peter P. C. Kremers, Philadelphia, Pa. App. filed Nov. 19, 1917. Upon breaking of a warp thread, signal is actuated to notify operator.

1,294,484. AUTOMATIC GAS CUT-OFF OF ALARM; Alexander I. Krynitzky, Philadelphia, Pa. App. filed April 24, 1918. Stops flow of gas or sounds alarm should flame become extinguished.

1,294,498. TELEPHONE-EXCHANGE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Nov. 26, 1917. Automatic switch mechanism released after starting but before completing its operation to interconnect subscribers' telephone lines.

1,294,514. PROCESS OF TREATING METALLIC OXIDES; James W. Moffat, Toronto, Ontario, Canada. App. filed April 30, 1918. Reduction of ore and melting of deoxidized material conducted in separate operations.

1,294,555. INDICATING SYSTEM; Richard F. Spamer, New York, N. Y. App. filed Sept. 8, 1914. For remote control of power generating and distributing systems.

1,294,557. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; Arthur B. Sperry, New York, N. Y. App. filed June 6, 1918. Pair of brush sets simultaneously hunt for desired line in two groups of line terminals.

1,294,575. INDICATING DEVICE; Frank D. Uomini, Palo Alto, Cal. App. filed July 12, 1917. For use on vehicles.

1,294,587. AUTOMATIC TELEPHONE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Aug. 25, 1914. Relates to part of system by which calling line is automatically selected and associated with remainder of office-selecting apparatus.

1,294,590. ELECTRICAL BALE-TIE WELDER; Lewis B. Wygant, Vincennes, Ind. App. filed Feb. 6, 1915. Welds bands and then severs wire ends.

1,294,597. ELECTRIC HEATER; Philip F. Apfel, Seattle, Wash. App. filed Aug. 27, 1917. Heated air within element used for igniting cigar.

1,294,599. POLE-CHANGING SWITCH; Edward E. Bair and James E. Stout, Hanover, Pa. App. filed Dec. 1, 1916. Allows current to flow in any direction.

1,294,607. ELECTRICAL HEATING DEVICE; Francis Boardman, New York, N. Y. App. filed July 13, 1916. For melting snow and ice in vicinity of railway switches, movable-point frogs, etc.

1,294,621. METHOD OF AND MEANS FOR SWITCHING CURRENT FLOW AT HIGH POTENTIAL; Nicholas J. Conrad, Chicago, Ill. App. filed Feb. 26, 1917. Replaceable switch used which is capable of only one operation and must then be renewed.

1,294,627. PROCESS FOR MAKING AND APPLYING JAPAN; Wheeler P. Davey, Schenectady, N. Y. App. filed Aug. 18, 1917. Risk attending use of inflammable solvent obviated.

1,294,644. ELECTRIC CONNECTOR; Charles H. Fischer, Cincinnati, Ohio. App. filed July 17, 1914. For vehicle electric lamps.

1,294,656. CONNECTOR; William P. Hammond, Passaic, N. J. App. filed April 18, 1914. Formed from single piece of sheet material.

1,294,664. SAFETY APPLIANCE FOR ELECTRICALLY DRIVEN MACHINE; Harvey E. Howey, Granite City, Ill. App. filed Nov. 19, 1917. Operates as a switch throw-out and dynamic brake.